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In this issue

97 Supply of Military Aircraft
99 "No Other Individual . . ."
101 The Pilot's Place
105 CL-28
108 "Comet 3½A" Powerplant
109 Hunters in Peru
111 Fiat Aviazione
115 Operational Angles on the B-47
126 A B-52 Comes to Britain

Recommendations—and Disclosures

AT the price of sixteen shillings there is now to be had of Her Majesty's Stationery Office a stout blue-wrappered octavo volume containing the Second Report from the Select Committee on Estimates and entitled *The Supply of Military Aircraft*. The cost of its printing and publishing is estimated, by the same office, as £1,199 15s, and the preparation for publication of the shorthand minutes of evidence is recorded as £340 5s 6d.

The committee having been ordered to report "what, if any, economies" might be effected, and finding itself faced with multi-million-pound transactions, the odd 6d bespeaks a seemly concern for public funds. The businesslike conclusions and recommendations are set out on page 98 of this issue, and first among the latter is one calling for more effort by the Ministry of Supply to obtain a contribution to research and development projects from the contracting firm, and for serious consideration of the proposal that this might be fixed at 20 per cent of the estimated cost, to be returned if the project went into production or was favourably reported on by the M.o.S.

There is much of value and interest not only in the general conclusions of the report but in the particular instances cited in evidence; and though answers to certain questions are piously stated to have been "suppressed for reasons of security," the resolute reader is often rewarded by references to such pulse-quickening projects as an all-steel supersonic research aircraft having a straight, thin wing; a Bristol bomber for which models were made before the scheme was abandoned; and an R.A.F./Army requirement for a missile which never materialized because the Army took up the American Corporal and it was decided as an economy measure that the R.A.F. should not have the same weapon. One reads, also, of a cancelled Vickers [air-to-ground?] "flying bomb"; but, most interesting of all, there are allusions to a rocket fighter (doubtless the SR.53) now said to be leading to another project that "will probably be ordered in substantial quantities by the R.A.F.," and to a supersonic naval strike aircraft—"really a bomber"—referred to (by inference) as N.A.39 and built by Blackburn.

Whatever the ultimate value of the report to the industry, the Ministries and the Services, any foreign air attaché or intelligence officer with an eye to business will find his sixteen shillings well spent.

Band of Brothers

THE disbandment of a great fighting force is, of all occasions, one to arouse emotion; and should that force have been founded in a spirit of voluntary service, then its dissolution may engender the strongest feelings—of resentment as well as regret.

Following the events detailed on pages 98-99 of this issue, centring on the disbandment of the flying squadrons of the R.Aux.A.F. and R.N.V.R., such feelings have, indeed, been manifested. The squadrons themselves (the four famous units of the London region in particular) were not slow to put their case. Their first manifesto proposed that, while a requirement for day-fighter squadrons remained, this could largely (and more economically) be met by the R.Aux.A.F. What they failed to point out was that the scheme could only be implemented if the squadrons were re-equipped with modern aircraft—a procedure hardly compatible with the official determination to reduce expenditure. Not surprisingly, this approach was soon relinquished in favour of a seemingly more practical proposal, whereby the Auxiliary squadrons would be attached to Regular R.A.F. units whose aircraft and facilities they would use at week-ends.

That the C.A.S. especially (as an old Auxiliary adjutant) countenanced disbandment after the deepest heart-searchings is not to be doubted. He of all people knows the worth of these "splendid young men, with their high enthusiasm and incomparable morale" (to quote the chairman of the Air League); and the Auxiliaries may take assurance that their plight is beheld by the nation, as by the Government, with the utmost sympathy. Any workable plan which might yet save the day will receive earnest consideration and measureless goodwill.

FROM ALL QUARTERS

Changes and Cuts

AMONG the Governmental changes announced last week were appointments affecting the Air Ministry and the Ministry of Supply. The new Air Minister is Mr. G. R. Ward, who was formerly Parliamentary and Financial Secretary to the Admiralty; and the new Minister of Supply is Mr. Aubrey Jones, who in the previous Government was Minister of Fuel and Power.

Mr. G. R. Ward.

Mr. Ward, who has been Conservative M.P. for Worcester since 1945, was Under-Secretary of State for Air from 1952 to 1955. He joined No. 601 Sqn., R.Aux.A.F., in 1929 and served in the R.A.F. from 1932-37. From 1937 to 1939 he was in the R.A.F.O. and he served in the R.A.F. in 1939-45, attaining the rank of group captain.

Before all the names of the new Government team had been made public, sharp cuts in defence expenditure were announced. These included the cancellation of orders for 100 Hawker Hunter fighters already placed, "as a result of a reduction in R.A.F. requirements," to quote from the official M.o.S. statement.

It is now widely believed that the aircraft strength of Fighter Command will be greatly reduced. A major object of such a reduction would be economy, but it would also allow the Command to concentrate more closely on the introduction of defensive ground-to-air missiles. Other major cuts in expenditure are expected.

Commenting on the M.o.S. statement, an Air Ministry spokesman was quoted as saying: "Final decisions on the strength of the front line have not been reached. We must await the Defence White Paper for any indication of our future force plans."

A spokesman for the Hawker Siddeley Group said that Hunter production had been going "at peak" at Kingston-on-Thames, Blackpool and Coventry and that in addition to R.A.F. requirements they had been meeting export orders worth £126m. Cancellation of the £15m M.o.S. contract would probably mean some redundancy among employees, but the extent of it could not yet be foreseen.

Round the World in 45 Hours

BETWEEN January 16 and 18, three Boeing B-52Bs of the 93rd Heavy Bomb Wing, U.S.A.F., circled the earth, in a non-stop flying time of 45 hr 19 min. Their average speed of 525 m.p.h. for the 24,325 miles was more than double that of a B-50 (94 hr) in 1949.

Five aircraft took off from Castle A.F.B., Calif., under the command of Maj-Gen. Archie Old. One, a reserve, stayed behind in Labrador; one peeled off near Portugal and landed at Brize Norton, Oxon (see picture below, and article on p. 126). The remaining three were fuelled by KC-97s near Casablanca, near Dharan, Saudi Arabia, and over Guam. A mock attack was made east of Malaya.

On their return Castle was shut by weather and a triumphant welcome was arranged at March A.F.B. The commander of Strategic Air Command, the redoubtable Gen. LeMay, presented each of the 27 crew-members with the American D.F.C. At least Gen. Old merited the award; he did not sleep during the flight.

STOPPING OFF: On January 18 one of the Boeing B-52Bs of the U.S.A.F. 93rd Heavy Bomb Wing (see above and p. 126) was inspected at Brize Norton, Oxon, by senior officers of the Royal Air Force. From the left: A. Cdre. G. A. Walker; Maj-Gen. James H. Walsh (commander, 7th Air Division); Maj. Clements; Air Chief Marshal Sir Dermot Boyle; Capt. Griffin; Maj. Jones; Lt. Cooke; Capt. Taylor; S/Sgt. Aroney; Capt. Sage; S/Sgt. Rouch; Maj. Skorheim; and Col. Edwin A. Loberg, base commander.

I.G.Y. Skylarks

TEST firings of the first of the Skylark I.G.Y. test vehicles, powered by a Raven solid-propellant motor built by Bristol Aircraft, Ltd. (Weston division), in collaboration with the R.A.E., Westcott, are to begin soon at the Woomera range in Australia.

The Raven gives a thrust of 11,500 lb for about 30 sec and the Skylark is expected to reach a height of 70 miles in its initial version, while more advanced models are designed to reach 120 miles.

If the proving flights proceed satisfactorily in the next few months, upper-atmosphere research flights with special equipment provided by the Royal Society will start in Australia at the beginning of the International Geophysical Year in July.

The Royal Society has announced that the first test signal of the I.G.Y., sent out by the Central Radio Propagation Laboratory, Boulder, Colorado, U.S.A.—implying that I.G.Y. observers should ensure that their apparatus is in full working order—was received at Dunstable at 1812 G.M.T. on January 10.

Research in the Netherlands

A SURVEY of aeronautical research in the Netherlands was due to be given before the Royal Aeronautical Society by Prof. Dr. Ir. H. J. van der Maas, F.R.Ae.S. (Technological University of Delft) in London last night, January 24. The paper described some of the work performed in the Netherlands in the post-war period, and the main installations now available. After a short historical introduction, the work of the National Aeronautical Research Institute (where the main part of the country's aeronautical research is concentrated) and of the Aeronautical Engineering Department of Delft Technological University was outlined. Aspects mentioned included aerodynamics (including investigations of flutter, helicopter problems, boundary-layer theory and gust loads); flight mechanics (including flight-test research); structures and materials. We hope to refer to the paper at greater length in an early issue.

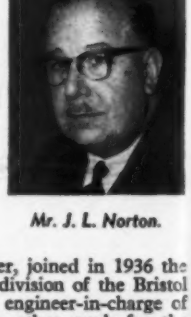
Vickers Reorganization

SEVERAL changes in the design organization of Vickers-Armstrongs (Aircraft), Ltd., were announced last week. They form part of what is described as "a general re-alignment of the design resources of the firm."

Under the new arrangement, design responsibility is now shared by three chief engineers, each responsible for a particular sphere: Mr. Basil Stephenson, F.R.Ae.S. (civil aircraft); Mr. H. H. Gardner, B.Sc., F.R.Ae.S. (military aircraft); and Brigadier J. Clemow, M.A. (guided weapons). Further details, and portraits, appear on page 119.

Bristol Appointments

AN announcement from Bristol Aircraft, Ltd., states that Mr. J. Lansdowne Norton, M.I.Mech.E., formerly chief designer, ramjets, with Bristol Aero-Engines, Ltd., has taken up the post of chief mechanical engineer, Bristol Aircraft, Ltd. In this new appointment, Mr. Norton has responsibility for the design of mechanical assemblies on Bristol helicopters and fixed-wing aircraft; and he will be directly responsible to Mr. H. Giddings, assistant chief engineer.



Mr. J. L. Norton.

Mr. Norton, who was behind much of the early engine design of many successful racing motor cycles built by Norton Motors, Ltd., a firm founded by his father, joined in 1936 the design staff of what was then the engine division of the Bristol Aeroplane Co., Ltd. In 1943 he became engineer-in-charge of special projects, being responsible among other work for the design and development of the Twin Centaurus power unit. In 1950 he was appointed assistant chief turbine development engineer (mechanical); and during 1952 he became chief designer, ramjets.

As we go to press another appointment is announced from Bristol—that of Mr. Basil Blackwell as assistant chief engineer of Bristol Aero-Engines, Ltd.

Supply of Military Aircraft

Points from a Critical Official Report

PREPARED by the House of Commons Select Committee on Estimates, a report* on the supply of military aircraft was presented to Parliament on January 18. Its recommendations are set out overleaf and further reference is made in a leading article, which alludes also to aircraft and missile projects of exceptional interest.

Evidence, taken from representatives of the Ministry of Supply, Air Ministry, Admiralty, Society of British Aircraft Constructors, Ministry of Defence and Treasury, occupies over 300 pages. The first session was on February 7, 1956, and the last on July 17, 1956, and the report is divided under these main headings: Aircraft and Equipment Ordered, The Organization of Supply, The Aircraft Industry, Contracts and Remuneration, Conclusion, Summary of Conclusions and Recommendations, Minutes of Evidence, Appendix. The first part is made up of an historical introduction and sections dealing with research aircraft, aircraft which did not go into production, Service aircraft, engines, electronics and guided weapons. The second part considers the Defence Research Policy Committee, the Ministry of Supply and development time; the third covers the size of the aircraft industry and the allocation of contracts; and the fourth deals with research and development, production, profits, contributions to research and development projects, and contract drafting.

Special consideration is given to the Vickers V.1000—"the most expensive of all the aircraft which were never produced." The report remarks that 1952 Air Ministry requirements for this long-range transport were very strict. It was intended to fly at the same height and speed as the Valiant, carry a large number of people and take off in a short space under tropical conditions. Development did not proceed as quickly as had been expected; some technical problems proved more intractable than people had first thought; and for these reasons, and because of the urgent need to re-equip Transport Command, the Air Ministry decided it would be best to rely on a civil type, the Britannia, although this did not meet their original requirements. The V.1000 was cancelled in December 1955, before a prototype had ever flown. None the less, the cost to the taxpayer was nearly £4 million.

Bombers, Missiles, Fighters

The M.o.S. witness was asked whether he did not feel that the Air Ministry could have been pressed to say earlier that it had no further interest in the project; but the only reply was an explanation of the reasons why the project had failed. No attempt seemed to have been made at the outset to ensure that the aircraft had a civil use. The M.o.S. representative agreed with another witness that in future the R.A.F., when requiring a transport aircraft, should take the most suitable current civil type and adapt it.

The cost of the Sperrin project was £3,500,000, but whether this "less successful interim type" could have been avoided and the Valiant alone produced was a question on which the Committee was not competent to decide. Dealing with a weapon "originally intended for use by both the R.A.F. and the Army," the Committee reports that it was finally decided that the Army could make do with the American Corporal, and the R.A.F. requirement was therefore dropped. The order for the original weapon was then cancelled, but not before £645,000 had been spent. This seems a clear case, says the report, where earlier consideration might have avoided waste. Work on a development of the Sturgeon as an "insurance" against Gannet development cost £490,000, and advanced versions of the Swift and Hunter, themselves insurances against failure of the P.1, cost £1,745,000 before being abandoned. Reference is made to a rocket aircraft—"more in the nature of research"—which (as remarked in our leading article) is expected to lead to large production for the R.A.F.

The history of the Swift is dealt with in considerable detail. An order for 100 was placed in November 1950, but thenceforth progress was beset with troubles. The first prototype crashed after three hours' flying and not until August 1952 was the first production aircraft flown. Throughout 1953 and 1954 modifications were made both to the aircraft and to the production contract. In this connection (it was pointed out to representatives of the Ministry), as the difficulties of the Swift increased so, it appeared, did the number on order. Even by March 1954, when no cure had yet been found to the aircraft's tendency to tighten in turns, nothing had been done to cancel orders. The Ministry's representative replied that tightening in turns affected every aircraft of the same generation as the Swift, and there was no reason to suppose then that it would not be possible to cure it. But the cure took much longer than expected, and after further trials early in 1955 the Air Ministry decided that the R.A.F. could not accept the Swift, except possibly for certain specialized roles. The strategic situation had changed considerably by this time, and the threat the Swift had been designed to meet was no longer of such importance.

In cancelling orders, the M.o.S. found difficulty, as large production had been set up and some aircraft were so nearly completed that they were more or less already paid for. Others were left on order for the "specialized roles." The total cost of the Swift project was estimated at £33 million. The S.B.A.C. suggested that at the time of the Korean war so much time had been spent "chasing the better instead of putting the good into production" that the R.A.F. was not equipped to the standard it could have been if existing aircraft had been accepted.

On V-bombers, although Sir Roy Fedden had said, "I am sure you have got to put your eggs in one basket" (the committee considers it significant that both Sir Roy and Mr. W. E. W. Petter would have "gambled" on the Victor), it was argued by Sir Frederick Handley Page that it was essential to have two centres of design as an insurance against one type failing. Sir Frederick advanced this view also on the general grounds that modern aircraft involved so much that was on the verge of the unknown that it was altogether too risky to rely on one design team.

Mr. Petter and the Gnat

Mr. Petter was asked to outline the history of the Gnat. He claimed that though there was a clearly expressed Service demand for the Gnat, it had not been produced—largely because the M.o.S. disbelieved in the general conception. The Ministry representative denied this criticism. He said the reason why the Gnat was not produced was that, at the time a decision had to be taken, no suitable engine was available.

To Mr. Petter's general criticism that fighters are becoming too complicated, and to a particular criticism of the Javelin made by another witness, the M.o.S. representative replied that, while Mr. Petter's concept was an attractive one, especially from the taxpayers' point of view, the only criterion in deciding what fighters to order must be the threat they would have to meet. Undoubtedly fighters were becoming more complicated, but so were the opposing bombers. No defence programme could be justified on the score of economy if it left the country without fighter defence in bad weather, or at night. This defence, on evidence, the Javelin did give. Nevertheless, it was clear that the M.o.S. were by no means satisfied with the fighter programme as it was at present, though on the grounds of delay, not of over-complication. This was shown by their attitude to Mr. Petter's suggestion that the best type of American fighter might be produced in this country under licence. Mr. Petter had put this forward "as the last hope of keeping an air force going when everything else has failed"; but the Ministry representative, while pointing out the difficulties involved in such a revolutionary decision, as for example the expense in dollars, the necessity of relying on American research, and the fitting of the aircraft's equipment, concluded with the words, "Having said all that, that is a policy which has not been excluded."

Lord Hives repeatedly stated that, in the present state of knowledge, too many engine projects were being carried on. Broadly speaking, the tendency was for engines to become even more similar. For this reason, he would have expected that economies could be achieved by cutting down the number of projects and by using the same engine for more types of aircraft. As aircraft grew more expensive, complicated and difficult to maintain there would have to be fewer of them. Moreover, the stage was being reached when fighters would no longer provide any protection, at any rate in the United Kingdom, and the place of conventional air weapons might be taken by ballistic rockets, for example, which "would put all the aircraft makers out of business."

The Bristol Aeroplane Company took the view that it was still necessary to maintain competition in the aero-engine industry, pointing to the technical controversy between the by-pass and straight-jet engines for aircraft of the V-bomber class.

In considering profits, the Committee recommends that a review should take place of the accounting arrangements of the contracts department of the M.o.S. to enable them to obtain accurate and up-to-date figures of the profits made by firms from contracts for research and development and production of military aircraft.

[*Continued overleaf*

*"*Second Report from the Select Committee on Estimates: The Supply of Military Aircraft," Her Majesty's Stationery Office, price 16s net.*

SUPPLY OF MILITARY AIRCRAFT . . .

The report concludes: "Your Committee feel it necessary to make two points quite clear. First, although they have drawn attention to certain weaknesses in the machinery of supply, it would not be fair to those concerned to give the impression that a great deal had not been achieved. On the contrary, we have produced some of the finest aircraft in the world, together with engines and various electronic devices. Secondly, while they are of opinion that the system of control of projects has not always worked well, still needs overhaul and opens a field for substantial economies, the saving by reducing the number of Service types of aircraft can be only a small fraction of the total expenditure under this heading.

"The programme for the supply of military aircraft has been an ambitious and expensive one. In some ways it has been shown to be over-ambitious. Your Committee are convinced that it is essential for all future projects to be scrutinized much more carefully than before to ensure that only the most essential are carried out. Failure to do this may well place the whole programme in jeopardy."

The conclusions and recommendations of the Committee are summarized as follows:—

Conclusions

(1) Although understandable in the economic circumstances of the time, the money spent on developing aircraft which were unsuccessful in competition, and which therefore never went into production, seems excessive, and the system itself one which should not be resorted to in other fields, such as missiles or equipment, without its objectionable features being fully taken into account.

(2) Insufficient care has been shown in limiting the number of helicopter research projects.

(3) Although the Supermarine Swift fighter has been a failure, the decision to order it was to a large extent inevitable. Nevertheless, it is not certain that adequate and speedy steps were taken to face up to the consequences of the Swift's failure and to reduce the number of aircraft on order once it became clear that its performance was not proceeding according to plan.

(4) In the particular circumstances surrounding the Victor and Vulcan V-bombers, the decision to proceed with the development and production of both was the correct one. So far as can be determined, it does not seem to have led to a waste of public money.

Recommendations

(1) The Ministry of Supply should make more effort to obtain a contribution to research and development projects from the firm awarded the contract, and should seriously consider the proposal that this might be fixed at 20 per cent of the estimated cost, to be returned if the project went into production or was favourably reported on by the Ministry of Supply.

(2) The system of control to ensure that research projects are not continued after they have outlived their usefulness should be reviewed.

(3) The present military aircraft programme should be critically examined with a view to ensuring that the number of projects is the absolute minimum consistent with security.

(4) There should be a review of the effectiveness of the Ministry of Defence's control of projects.

(5) The Ministry of Supply should pay more attention to the cost and effect on the aircraft industry's resources of a project originating either from a Service Department or one of their own research establishments.

(6) Aircraft manufacturers should have the earliest and fullest access to information about equipment to be fitted in the aircraft they manufacture and the "Service Fit" system should be reviewed to see if it is really necessary.

(7) The Service Departments should consider the possibility of accepting delivery of a certain number of earlier versions of an aircraft, even though these may not fulfil completely the operational requirement, and use them pending production of later modified marks.

(8) Officers appointed to the post of Controller of Aircraft and other posts connected with the ordering of aircraft at the Ministry of Supply should have longer tours of duty than at present, and every effort should be made to appoint officers with technical qualifications.

(9) Investigations should be carried out to ascertain and compare the length of time taken to develop a military aircraft in the U.K. and the U.S.A.

(10) Steps should be taken, preferably with the agreement of the industry, to limit the number of firms receiving Government contracts for the manufacture of airframes and aero-engines.

(11) The Ministry of Supply should use the method of selective allocation of contracts to bring about the measure of coalescence in the aircraft industry which they agreed was desirable.

(12) A review should take place of the accounting arrangements of the contracts department of the Ministry of Supply to enable them to obtain accurate and up-to-date figures, year by year, of the profits made by firms from contracts awarded by the Ministry of Supply for both the research and development and production of military aircraft.

(13) The Ministry of Supply should investigate the possibility of abuses arising from contract draughting and should ensure that the technical costs department of the Ministry have sufficient data to enable them to carry out their functions in checking the costs of firms properly.

THE R.Aux.A.F. and R.N.V.R. DISBANDMENT

As briefly indicated in these columns last week, the major part of the Royal Auxiliary Air Force and the entire air branch of the R.N.V.R. is now being disbanded. Operational training ceased on January 10 and the administrative processes of disbandment will be complete by March 10. Thus ends what may yet prove to be just the first phase in the history of Britain's territorial air arm. A list of the disbanded and retained units appears on page 125.

There are many who consider it unwise to dispense with the fighter squadrons of the R.Aux.A.F. But it is clear that, in their present form, these units cannot continue to contribute effectively and worthily to the country's defence. Military aircraft are becoming increasingly expensive both in first cost and operating cost, and it is certain that the tendency will be to reduce their numbers in peace-time air forces. The question of whether the remaining fighter aircraft should be operated by Regulars or by Regular and Auxiliary pilots has now had to be decided; and the choice has reasonably and rightly fallen to the Regulars. There has been no effort to discriminate against the Auxiliaries and no question of animosity or ill-feeling. The final decision was taken with the greatest regret.

There is, furthermore, no question of the Auxiliary pilots' not being able to handle fighters at present coming into service or soon expected; and no qualified person has yet said that such might be the case. Arguments of this kind are not new; they were put forward even before the R.Aux.A.F. was first founded in the 1920s. Each re-equipment has been greeted with similar doubts. Yet many Auxiliary pilots have flown the Hunter successfully and found no difficulty in doing so.

But the fact must be faced that there is no point in continuing voluntary training which is, after all, not without its risks, when the Meteors and Vampires in which this training is carried out offer no answer to the air-attack threat which Britain might expect. For the pilots themselves there would be no real reward and no one would ask them to continue their work in a lost cause. But any reasoned proposal for another way of using the magnificent voluntary spirit would doubtless be seriously considered.

After being told of the disbandment order, the Auxiliaries themselves, not unexpectedly, immediately took action to bring their plight to public notice. Very soon the opinions were published of many people well qualified to speak. Towards the end of last week a concrete proposal was being formulated by the Auxiliary squadrons in the London area, whereby they could continue to contribute to the country's defence with modern fighters, and retain at least the bare essentials of their corporate existence and connection with their parent city and counties. The basis of the proposal was expected to be that the squadrons would base themselves at their respective town headquarters and concentrate there their administrative offices. Working from these headquarters they would offer to provide pilots and ground crews to operate the day fighters of the regular squadrons during week-ends at any airfield within striking range of the headquarters. Thus a London squadron would offer to provide pilots at one of the main fighter bases in the home counties. It would be easy to foresee that these stations might be kept open at week-ends, using extra staff drafted in after the closure of airfields which have up till now been operated mainly for Auxiliary squadrons.

By developing this scheme it might be possible to provide a seven-day coverage of defensive day fighters, using Auxiliaries at the times when the Regulars have their week-end. A scheme on these lines is already operated by the U.S.A.F. in America, the reserve pilots of the Air National Guard taking over the operation

of F-100 supersonic day fighters and other types. It is claimed that the demand on R.A.F. resources would not be as high as might at first glance appear.

Personnel of disbanded R.Aux.A.F. squadrons have at the moment four choices of action and comparable opportunities exist for R.N.V.R. Air Branch personnel.

They can transfer to one of the remaining Fighter Control Units, subject to suitability and vacancy, or they can transfer to the R.A.F.V.R. and serve with the Reserve Flights supporting R.A.F. Stations near their homes. Officers may find vacancies in the R.Aux.A.F. General List for specific war appointments, or they may transfer to the inactive R.Aux.A.F. Reserve. Anyone may completely sever his connection with the Service. None of these alternatives offers the opportunity of continuing flying; and the pilots, at least, are not very likely to take advantage of them.

The history of the R.Aux.A.F. goes back to 1919, when Lord Trenchard's White Paper insisted that non-Regular squadrons were a necessary part of the R.A.F. It was not until 1924 that legislation was finally passed; and the first five squadrons were formed in 1925. They were Nos. 600 (City of London), 601 (County of London), 602 (City of Glasgow), 603 (City of Edinburgh) and 502 (Ulster) Squadrons. All 20 squadrons were in being by 1938, all of them in the day or night fighter rôle by the beginning of World War 2. By their war record these units fully justified Lord Trenchard's hopes for them. Out of every three enemy aircraft destroyed in the Battle of Britain, one fell to the Auxiliaries. No. 616 was the first R.A.F. unit to fly jets.

After the war, the Auxiliary Air Force (it was accorded the prefix "Royal" on December 16, 1947) was re-formed and, in 1949, re-equipped with jet fighters. The years since have seen a steady expansion in the ground squadrons and a successful contribution to the country's air defence within Fighter Command.

The peace-time R.N.V.R. Air Squadrons were first formed in 1947, beginning with a number of fighter units. From Seafires, equipment steadily advanced to Sea Furies and then Attackers, until finally many squadrons received Sea Hawks, the Fleet Air Arm's most modern day fighter. At the same time a number of anti-submarine squadrons were formed with Fireflies, and these machines, too, were steadily brought up to date in later marks and finally replaced in some units with Gannets, again the latest equipment available. Many squadrons went to the deck during their annual 15-day training period; and in 1949 No. 1830 Sqn. won the Boyd Trophy, the highest annual award in the whole Fleet Air Arm, while embarked in H.M.S. *Theseus*. In the middle of 1952 the squadrons were re-organized in four Air Divisions to facilitate expansion. A fifth Air Division was formed just over a year later. One squadron was only in existence for two years, leaving eleven to be disbanded now.

"NO OTHER INDIVIDUAL . . ."

MANY and warm were the tributes paid to Lord Hives, C.H., M.B.E., on the occasion of a dinner in Derby on January 11, to mark his retirement from the position of executive chairman of Rolls-Royce, Ltd.

Lord Kindersley, the new chairman, described him as "the man who has done more for Rolls-Royce during his working life than any other individual in the history of the company." He left the company when its name stood higher in the world than it had ever done.

Mr. J. D. Pearson, the new chief executive and deputy chairman (known, in conformity with Rolls-Royce tradition, as "Psn"), recalled that "Hs" had supervised the first run of the Eagle and that for his contribution to aero-engine development during the First World War he was appointed an M.B.E. in 1920. Mr. Pearson was certain that Lord Hives had had a lot to do with the recommencement of aero-engine development at Rolls-Royce in 1925. History records, he said, that in June 1927 the Kestrel completed an official 100-hour type-test at the first attempt. He went on to refer to the "great days of the R engine" with Hs right in the thick of it, and to the decision by the Board in 1932 to go ahead as a private venture with a 1,000 h.p. engine—later to become the Merlin. In 1936 Lord Hives was appointed general works manager, and a few months later he joined the Board. In the war years no single individual made a greater contribution to the development of the Merlin than Hs himself, and Mr. Pearson recalled the famous Beaverbrook telegram: "Hives, Rolls-Royce, Derby: The British Government has given you an open credit for £1,000,000. This is a certificate of character and reputation without precedent.—Beaverbrook."

In 1946 Lord Hives became managing director and in 1950 was unanimously elected as chairman of the Board in addition to being its chief executive, thus breaking with the tradition that the chairman should not be an executive of the company. Mr. Pearson went on, "In further recognition of his continually increasing status in the country as a whole he was awarded the Royal Aeronautical Society's Gold Medal for work on aero-engine development, an honorary degree of Doctor of Science at Nottingham University and an honorary degree of Doctor of Law at Cambridge University. Latterly he has been called upon by the Government to be chairman of the National Council for Awards for Technology, and I am certain that there are many bodies which are only waiting for Hs's retirement to find him a lot of jobs to do." Mr. Pearson concluded, "Finally, Hs . . . a personal tribute which I know will be echoed by every single person in this room: Our lives are richer and we are better men for having known you. God bless you."

Mr. C. P. Jones, general works manager, said of Lord Hives, "His denigratory descriptions of himself as 'only a plumber' or 'an ordinary mechanic' cover his essential modesty, and his expression that '99 per cent of our troubles are due to something b—y silly' has on many occasions given the clue to an obscure trouble by making one look for the obvious."

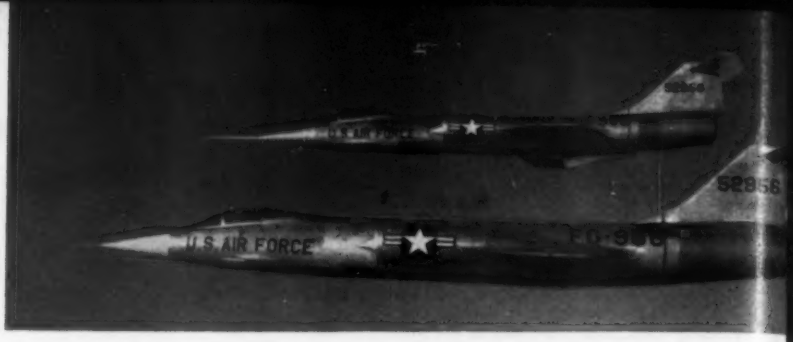
Mr. Alf Brown, works convener, said that, provided one remembered to lay aside those rose-tinted spectacles, looking back could be a very useful thing to do. He went on, "It is a thing

Lord Hives replying to the tributes. From left to right are Mr. A. F. Kelley, Dr. F. Llewellyn Smith, Mrs. J. D. Pearson, Lord Kindersley, Lady Hives.

I have to do quite often to enable me to keep a proper sense of balance in the face of the relentless attack of the few dismal jimmies—often a very noisy minority, who interpret any little irritation as a move for the worse, and set up a shout about 'the good old days' and what they used to do and what they didn't do. The good old days indeed! The phrase recalls for many of us such things as the symbolic significance to the workers of Derby a quarter of a century ago of the letters R.R. They certainly didn't mean Rolls-Royce in those days. No, they stood for 'Rush 'em and Rest 'em'—three months at work, and then three months on the dole. Yes, and three months of work under harsh conditions. It was something we seem rather reluctant to talk about these days—although heaven only knows why we should be, because it is only by looking at things as they were that we can get a measure of the progress we have made. And today those same letters to the same people mean security, good wages, good conditions and good relations. And this hasn't been brought about, as some people would have us believe, by the simple exercise of evolution. It has been brought about, to a great extent, due to the remarkable foresight of one man: Lord Hives."

Lord Hives confessed himself "overwhelmed" by the kindness which had been shown to him and his wife. "When you have got rid of the old man," he said, "you will see that the average age of the directors is about 51." He went on: "I inherited Rolls-Royce as a going concern. I don't want ever to overlook the creators of this great enterprise. We can never forget Royce's name; it will last and live for ever. Don't neglect Claud Johnson, C. S. Rolls and Wormald. They were the people that sowed the seeds. They cultivated the plant in order to establish good strong roots—because Rolls-Royce was in those days built on a policy of thrift and very strict economy. Anybody who had the privilege of meeting Royce knows what that means. And don't overlook the fact that this is no longer a successful industrial firm. It is a national institution."

HERE AND THERE



NASAL ACCENTS: The new picture of Lockheed F-104As (top) emphasizes the "needle nose" and shows a firing port for a Vulcan six-barrelled 20 mm gun and the double-shock air intakes. Prominent, even in the nose of its monster Douglas C-124 test-bed, is a Pratt and Whitney T57 turboprop—at 15,000 h.p. the most powerful of its kind.

Pembrokes for Germany

AN announcement from Hunting Percival Aircraft, Ltd., says that they have signed a contract worth "more than £2m" with the West German Government for the supply of Pembrokes. Deliveries are scheduled to begin within a few months.

Syrian Rumours

THE U.S. State Department said last week it had received "unconfirmed reports" that aircraft of Soviet origin, believed to be Mig-17s, had been delivered to Syria. There are also reports of Soviet technicians and pilots there.

Née Ouest

THE two French companies Sud-Est and Ouest Aviation have been united as the Société Sud Aviation. The president of the new company, M. Georges Hereil, said that the merger would speed production of French aircraft and add to the expansion of the industry.

Low-cost Kolibrie

THE cost of the Kolibrie H-3—which its designer, in a description for *Flight's* special helicopter issue last November, said had "a low initial price"—has now been quoted as 70,000 guilders (about £7,000). This, it is claimed, makes it the cheapest helicopter in the world.

Kingly Gesture

IN the early hours of January 11 King Hussein of Jordan saw from his palace an aircraft circling Amman airport and realized it was in trouble. He drove to the airport, ordered the runway lights to be put on and personally made radio contact with the pilot of the aircraft, a Lebanese airliner *en route* from Beirut to Kuwait. It subsequently landed safely.

Bell Appeal

AN order from the U.S. Army for 84 H-13H helicopters and spares, on a fixed-price type of contract amounting to more than $3 million, has been announced by the Bell Helicopter Corporation. This is in addition to previous contracts, under which the Army has ordered 105 H-13Hs (military version of the 47G-2) for use as liaison and training aircraft.

Used-car Wisdom

CURRENT prices for used cars and the facts about this much-discussed market are the subject of an enlarged special-feature issue of our associated journal *The Autocar* next Friday (February 1). Practical information and advice on purchasing a used car will be included, in addition to several special articles and all the usual features.

Helicopter Pioneer

NAMED as the first man in this country to fly a helicopter, Mr. Robert Graham, C.B.E., F.R.Ae.S., has retired from the Civil Service after nearly forty years and joined private industry with Microcell, Ltd. While he was at the R.A.E., Farnborough, from 1920 to 1926 Mr. Graham was seconded to Mr. Louis Brennan, whom the Air Ministry had commissioned to design a helicopter; and as test pilot and chief engineer he flew the Brennan helicopter in 1925. The Air Ministry, however, decided not to proceed with it. During the last war Mr. Graham was concerned at the R.A.E. with pressure cabins, high-altitude equipment and aircrew safety equipment. He designed the egg-shaped air-pressure chamber for Sir Winston Churchill's wartime flights. He went to the Ministry of Supply in 1950, his last post being Director of Aircraft Mechanised Engineering Equipment, Research and Development. He is to be technical director of Microcell, Ltd., responsible for research and development in the aircraft and mechanical engineering divisions at Camberley, Surrey.

Agricola for N.Z.

THE first Auster Agricola to be sold in New Zealand was delivered recently to Airlift (N.Z.), Ltd., of Rongotai Aerodrome, Wellington. The chief pilot and manager of the company, Claude R. Stephenson, has successfully completed a variety of operations (dropping superphosphate, lime and basic slag) with the Agricola in his first 60 hours on the type.

All Aboard

PREFERENCE for aircraft carriers rather than land bases for French air forces was recently expressed by Admiral Henri Nomy, Chief of Staff of the French Navy, quoted by Paris Radio. Land bases suffer from "nationalist troubles," he said. The last war had shown that the aircraft carrier would remain the backbone of the great navies, and this was more true today than ever before.

Philip Kidson Joins S.B.A.C.

FORMERLY in charge of publicity at A. V. Roe and Co., Ltd., Manchester, Mr. Philip Kidson has joined the technical and exhibitions section of the S.B.A.C. At the time his resignation from A. V. Roe and Co., Ltd., was announced it was stated that Mr. Kidson was seeking an appointment in the south of England for the benefit of his wife's health.

PIONEER AIRBORNE: A hitherto unpublished photograph of the Brennan helicopter in flight (see news item above). The 60ft rotor was driven by small propellers at two of the blade-tips, powered through shafting from a 230 h.p. B.R.2 (Bentley rotary) engine mounted horizontally.

THE PILOT'S PLACE

A Consideration of Cockpits, Then, Now and Tomorrow

By L. F. E. COOMBS

IN the earliest days there were no cockpits, let alone flight decks; the pioneers of powered flight had to sit directly on the structure of their machines. Protection from the airstream was considered even less necessary than in motor cars, some of which at least had rudimentary windscreens.

As with other vehicles, the position from which an aeroplane is controlled has depended primarily on the location of its controlling parts, such as the elevator and rudders. It has never been mandatory that the control positions of any kind of vehicle should be at the very front because that is the best place from which to observe obstructions; the steam locomotive has almost always had its control platform mounted at the rear of the boiler.

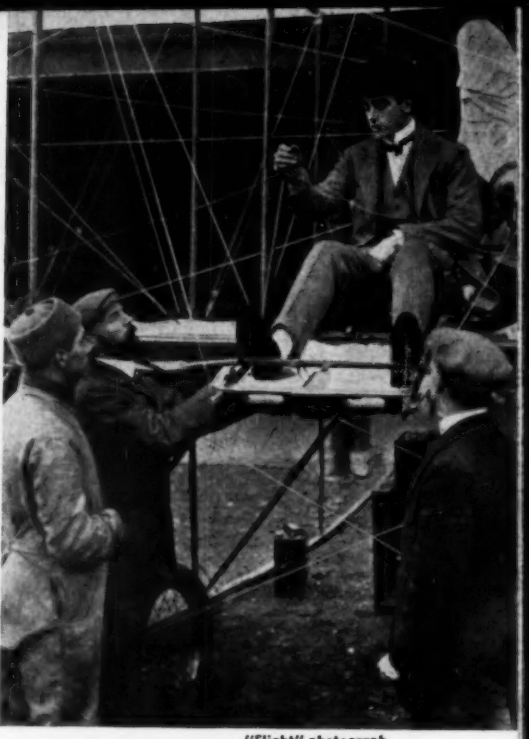
In aircraft, the next step was the unroofed cockpit, which, with only one or two exceptions, was the rule until the early 1930s. In summer weather at medium altitudes it offered most pleasant flying; in cloud or precipitation less so.

When enclosed cabs were first tried on locomotives in Britain some of the drivers and firemen said they felt shut in and could not see properly. Confronted by an enclosed cockpit, a good many aircraft pilots adopted the same attitude. In fact, whilst some of the early passenger machines had enclosed coupés or cabins, the pilot still sat with his head in the open—and preferred it that way.

Like the bridge of a ship or the cab of a locomotive the cockpit of an aircraft is a necessary evil. In addition to occupying valuable space and adding to the drag, it has to accommodate a pilot who insists on leg- and elbow-room, stowage for an essential miscellany of equipment and controls, and (an elementary requirement) instruments so positioned that two eyes, two hands and two feet are a sufficient number of appurtenances for control.

Nowadays, the control positions of an aircraft—large or small, civil or military—are placed as close to the "sharp end" as is practical. In contrast, some early single-engined transport aircraft had the passenger cabin between the pilot and the engine; and in the Gee Bee racers of 1935 the pilot actually sat in the fin.

Before aircraft became broad in the beam it was customary to place dual piloting positions in tandem; such an arrangement also favoured simple control runs. When it became possible to have two pilots sitting side-by-side again—some of the very early "string" aircraft had an athwartships pilots' plank—the question must have arisen: "on which side will the principal command position be located?" If the left-hand circuit was introduced before side-by-side piloting, then it is possible that it had an influence on the choice by satisfying the right-handedness of most people. The right hand would instinctively be on the "tiller" whilst the left operated the other controls; at the same time a turn to the left, with the head over the side, would be easier with the right hand on the stick. This may have encouraged a predilection for a left-hand circuit and for the left seat to be the commanding position.



". . . there were no cockpits, let alone flight decks; the pioneers of powered flight had to sit directly on the structure of their machines." Claude Grahame-White with Henri Farman in 1911.

"Flight" photograph

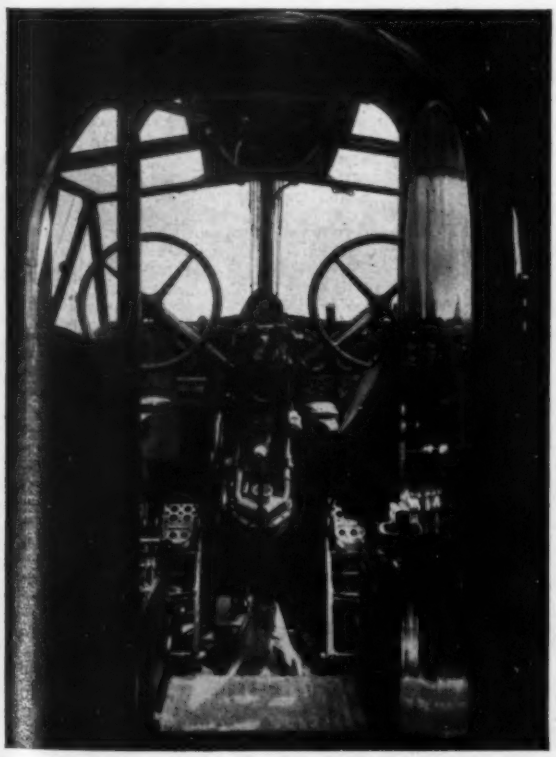
The helicopter, incidentally, with its right-hand command, has upset an almost fundamental rule of transport that the commanders of opposing vehicles should pass shoulder to shoulder. The rules of the air ensure that captains of fixed-wing airliners sit on the passing side; road drivers do likewise.

Determining the true reason for the location of the command position is as difficult as collecting the reasons why the movement of rudder pedals or rudder bar is opposite in effect to the handlebars of a bicycle.

Cockpits as they are today only began to assume a definite form in the early 1930s. With the advent of such aircraft as the Handley Page H.P.42, both flight and communication controls—for the use of two pilots—were concentrated in a specialized compartment. Despite the H.P.42's four engines its flight deck was not encumbered by a multitude of instruments; the two largest items—and they *were* large—were the dual control wheels.

In the years between the Vickers Vimy bomber and the H.P.42, controls had remained very much the same—particularly the small details such as switches, which were a genuine domestic type with a brass screw-on cover, sometimes fluted.

Although American aircraft were amongst the first to have full flight-deck instrumentation and the multitude of levers and switches attendant upon retractable wheels, variable-pitch propellers, flaps and more complicated engines, they failed to have a logical, easy-to-read arrangement of instruments. The standard British blind-flying panel of six basic flight instruments, introduced by the R.A.F., was not adopted in the United States. American aircraft, both civil and military, had "mixed-up" instruments. But switches and levers were, on the whole, grouped in more logical arrangements than in British aircraft (the designers of which in 1940 screwed control-handle brackets and quadrants to all parts of the cockpit, irrespective of the physical contortions required to operate them). Nowadays we read of air brakes which can be applied without taking the hand off the throttle or wheel, simply by extending the finger tips. In 1940, R.A.F. pilots would come off the Miles Master trainer—which had a concentration of engine,



"Flight" photograph

"Despite the H.P.42's four engines its flight deck was not encumbered by a multitude of instruments. The two largest items . . . were the dual control wheels."

"Flight" photograph

"In contrast, some single-engined transport aircraft had the passenger cabin between the pilot and the engine." The D.H. Fox Moth.

THE PILOT'S PLACE . . .

propeller, flap and undercarriage controls—and go on to Spitfires, in which it was necessary on take-off to remove the left hand from the throttle—hoping it would not inch back—and change hands on the stick so as to be able to operate the undercarriage lever on the starboard side of the cockpit. In the Wellington the cockpit contained a very functional control pedestal on the left of the pilot's seat, but the flap and undercarriage levers were inconveniently located on the centre line of the instrument panel.

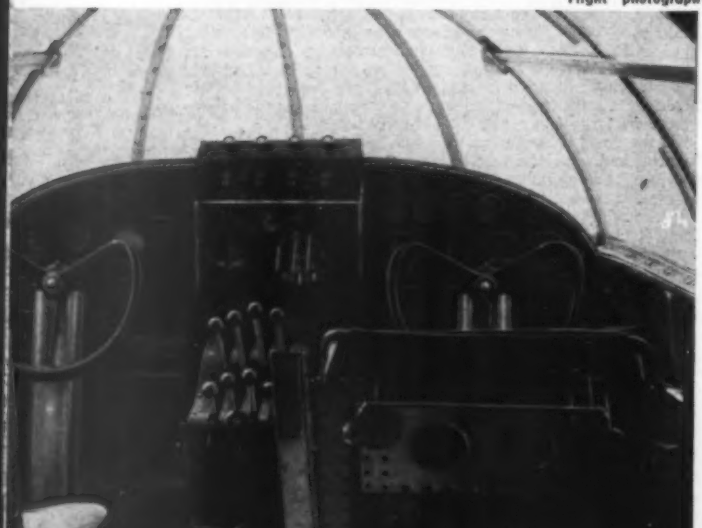
As the Wellington and other British heavy aircraft of their time (among them the Halifax and Lancaster) were primarily intended for one-pilot operation, the cockpit was a raised shelf on the port side, with a gangway to starboard. In contrast, United States medium and four-engined military aircraft borrowed from the current civil practice of incorporating full dual control around a central pedestal.

American twin-engined attack aircraft such as the Boston, Havoc, Baltimore and Maryland had cockpit dispositions similar to those of the British Beaufighter and Hampden. In these aircraft the pilot sat between two shelves, each of which was covered with levers, switches, wheels and buttons.

A new concept in flight deck layout was introduced with the

The Short Empire flying-boat ". . . had more square feet of flight deck than the [larger] Constellation."

"Flight" photograph



B-29. The layout, which incidentally is perpetuated by the Russians in the Tu-104, provided two piloting "shelves" on each side of a central gangway leading into the nose portion of the flight deck. Separate control pedestals were situated outboard of each pilot. In the 314 flying-boat Boeings used a similar control pedestal arrangement, but with contiguous instrument panels. The B-17 Flying Fortress had a central pedestal carrying the principal levers; and the throttles were ganged by hefty cross-handles, so that all four or a pair of engines could be operated together. Another unusual feature was that the flight instruments were not duplicated, so that with the paired engine instruments in front of the second pilot and the flight instruments in the middle, the captain's instrument panel sported virtually nothing more than an eight-day clock and a few lights.

While the layouts adopted for military aircraft make a most interesting study they cannot contribute much to civil aircraft design, as the requirements are so very different. In some respects it is true to say that large military aircraft have not had the same degree of concentration of instruments and controls as in a civil aircraft, where revenue considerations make it necessary for the designer to push the operating crew and their equipment into the smallest possible volume. Air force aircraft have either had the minimum crew compressed into the smallest cockpit, as in the Mosquito or modern jet fighter/bombers, or each member of a very large crew has had his own private office—as in the Wellington and other British bombers. Nowadays, pressurization and centralized weapon control have made designers concentrate the three- or five-man crew of a jet bomber into one compartment.

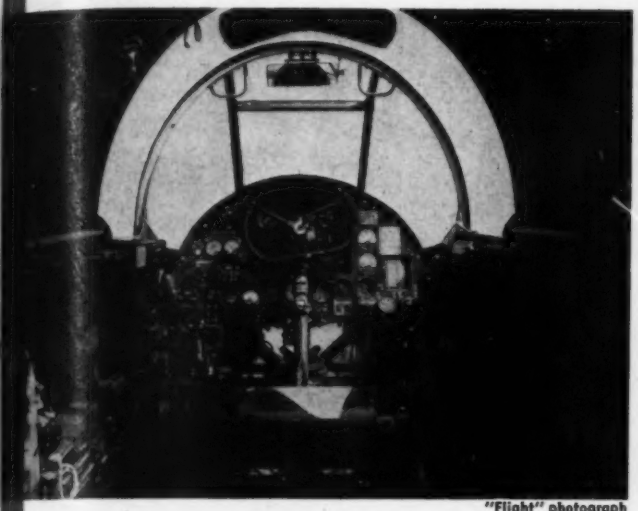
Despite the numerous variations that have been tried there is a general tendency for the layout of the pilot's part of the cockpits of medium and large civil aircraft to settle down to a common pattern: a central control pedestal flanked by the pilot's seats facing the main instrument display. Other members of the crew, such as flight engineers and navigators, do not fare so well and are given the meagre accommodation that remains after the two pilots have staked their claim for floor space. For some reason not all designers agree with the elementary principle that a flight engineer should sit facing forward so that the instruments and controls on his panel are related to the actual disposition of the aircraft's components. Admittedly, the use of the terms "port" and "starboard" is supposed to prevent confusion, but during an emergency it is very easy, when facing aft, to select the wrong extremity of a row of switches. Incidents have occurred, and will continue to occur, unless the relationship between similar and handed instruments and controls is given the most careful consideration. The latest issue of British Civil Airworthiness Requirements recognizes the potential danger of the flight engineer "with his back to the engine" and therefore prohibits such an arrangement.

When the Stratocruiser was developed from the B-50 a new flight-deck layout appeared. The principal innovation was the provision of gangways outboard of the pilot's seats (access to the co-pilot's seat is outboard of the flight engineer's panel), which allowed them to sit down without having to push by or jump over the central control pedestal. The Stratocruiser layout was designed to make the co-ordination of the work of the three flight-crew members—captain, co-pilot and flight engineer—as easy as possible, and at the same time it allowed the installation of a simple arrangement of dual throttle and propeller controls. In this aircraft the flight engineer can either face forward—so that he can use the pilot's controls on the central pedestal—or face the main engine and services panel on the starboard side of the flight deck.

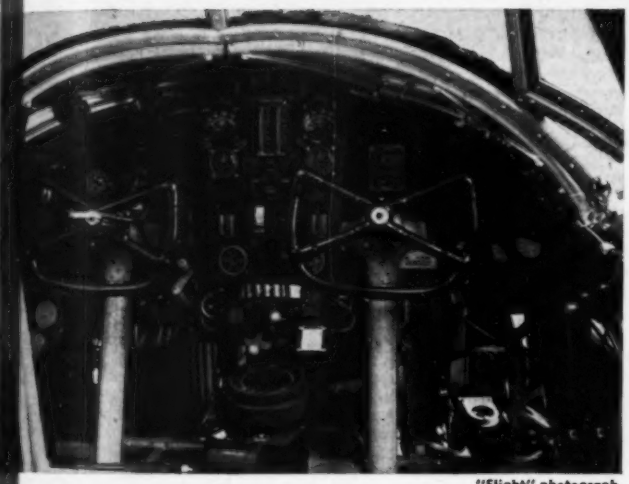
Possibly the Stratocruiser layout is the best combination of crew positions, visibility characteristics and crew comfort developed since the demise of the flying-boat. Of course, such a spacious deck takes up valuable revenue space, and consequently is not very popular outside piloting circles. The minimum width of fuselage required for "outside" access to the seats makes it necessary to push the crew as far into the pointed nose as possible and compromises even the best intentions towards crew consideration. It does not look as though the Stratocruiser layout will be perpetuated in other designs, which is a pity, for although it has faults it does have a majesty in keeping with the rest of the aircraft.

Both pilots and designers must be influenced to a certain extent by the control layout of an aircraft type or series which exists in large numbers throughout the world. An example is the DC-4 and its successors. The Douglas company have managed to make the layout of the flight deck independent of the type of service or operation so that the same DC four-engined aircraft can be operated on long- and short-haul internal routes, on transatlantic services or as a military transport. The three-on-a-bench type of control position has proved to be adequate for most types of service. The captain, flight engineer and co-pilot sit in front of an instrument panel and a pedestal which forms a control facia extending from deck to roof, broken only by the windows at eye-level.

The general observation which can be made after studying the



"Flight" photograph



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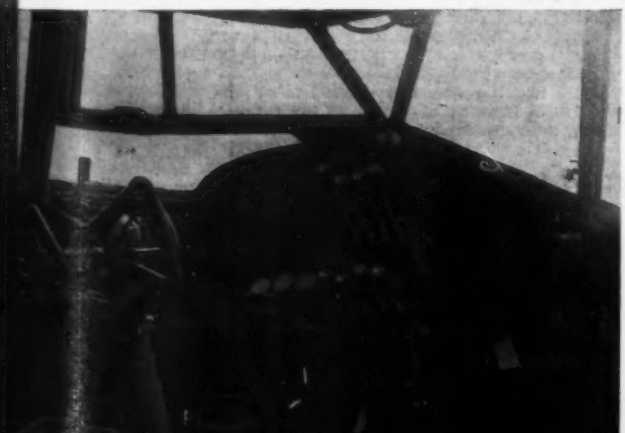


Three World War 2 bomber interiors. Reading downwards, Hampden, Wellington (as adapted for dual control), and Halifax.

aircraft designs of the world is that the size and layout of a cockpit have no relationship with the size of the aircraft. The Short Empire flying-boats had more square feet of flight deck than, say, a Constellation, although the latter is a bigger aircraft both in weight and size. Even complexity does not seem to influence flight-deck size. It might be argued that the size of a flight deck must depend on the crew complement and the length of the route. In practice there appears to be a minimum acceptable crew complement and number of control positions which must be "frozen" on the drawing board at the earliest possible time during the development of the prototype if progress is not to be impeded.

The designer of a cockpit has the unenviable task of trying to please all the interested parties. Obviously he must please the customer, who has supplied a specification of cockpit details. If these have been gathered from the opinions and experiences of his pilots the optimum layout can be obtained in the minimum time. Unfortunately, the designer can neither turn to one standard of design practice nor to one customer specification. He has to attempt to satisfy the British Civil Airworthiness Requirements, the United States airworthiness code, the principal customer and the conflicting requirements of other possible users. In addition to national standards there is a definite need for pilots, as a body, to determine their requirements so that designers have only one source of reference to pilot opinion. Perhaps the day will come when I.C.A.O. issues an international standard of flight-deck requirements which is based upon the best international practices.

When instruments and controls were few in number the need for careful cockpit layout was not really necessary. The introduction of more complex devices with their attendant extra levers and dials made designers more concerned with making them function correctly than with installing them in the best physical position for operation by the pilot. It is not so many years since engine instruments in multi-engined aircraft were on the side of the engine nacelles. On a dirty night the pilot needed a strong torch and more than a cursory glance to check the oil pressure.

In the past, unsatisfactory cockpits—from the pilot's point of view—have been caused by a lack of co-operation and liaison between manufacturers and operators and between operators and pilots. This is partly because pilots do not usually complain about the control position as a whole unless they have had a very eventful trip during which they have become acutely aware of the uncomfortable seat, poor air conditioning, an inability to co-ordinate the flight instruments after two hours' instrument flying on airways, and so on. If they have had an "on schedule" flight with everything working as it should, then they are slow to criticize.

Until recently B.C.A.R.s did not impose any extensive cockpit requirements other than those necessary to ensure that the various control levers and switches were designed to operate correctly. As is the case with other sections of B.C.A.R.s, the manufacturer is relied upon to use his extensive experience and not be made a slave to a set of paper requirements. But the regulations did not guide the design of controls and cockpit equipment in a way that would encourage a layout in which the pilot had adequate visibility, comfortable seating, and logically positioned instruments and controls. As an example, a wing-flap control lever is covered by a requirement relating to the shape of the quadrant and a recommendation that the lever be so positioned that the pilot, when reaching for other levers and switches, cannot inadvertently operate the flap control. But there is no requirement which prevents a designer installing the flap lever at the back of the pilot's neck. In practice, of course, the A.R.B.'s assessors would no doubt comment most unfavourably on such a position.

By making more detailed requirements and recommendations, the most recent issue of B.C.A.R.s has gone a long way towards the encouragement of better cockpit layouts; but they still leave the designer without a guide to the overall layout. The Boeing 707 and the Vickers Vanguard, in contrast, have been designed in accordance with the principles of the Society of Automotive Engineers, which endeavour to cover all aspects of cockpit layout.

For many years now the pilot's position, be it an imposing flight deck or a humble cockpit, has been an integral part of an aircraft. Entry to the flight deck is either up the gangway and through a "private" door or (possibly the most imposing way) by a dignified walk through the passenger decks and forward into the suite of offices reserved for the pilots and their assistants. In a military aircraft the entry to a confined cockpit is usually up a series of hand- and foot-holds, after the manner of Hillary and Tensing, or up and over on a ladder which is later removed.

There is a tendency for two distinct types of "office" to emerge, the spacious and the confined. The future development of aircraft is, perhaps, going to have more effect on the design of single-place cockpits than upon the layout of flight decks. Due consideration will, of course, have to be given to the problem of visual look-out for civil aircraft in crowded airspaces.

Single-seat military aircraft will soon be operating in conditions which will prohibit the use of conventional cockpits, because the human senses cannot be subjected to the intense light effects and the extreme heat conditions which will obtain during flight at

(Top left) "The Stratocruiser layout was designed to make the . . . work of the three flight-crew members . . . as easy as possible." (Top right) Tu-104 layout, providing pilot "shelves" on each side of a central gangway leading to the navigator's nose-position. (Left) The Boeing 707 flight-deck, "designed in accordance with the principles of the Society of Automotive Engineers."

THE PILOT'S PLACE . . .

speeds of Mach 2 or higher, and at altitudes which will range from sea level to 100,000ft in a matter of a few minutes.

The aircraft of the future may have to have a self-contained command capsule. It would be resistant to severe temperature and pressure changes so that its interior is maintained at a constant pressure, humidity and temperature. The capsule would provide an environment within which the man-machine command unit can operate and be recovered should the aircraft be destroyed; it represents the limit to which the man-machine unit can be developed.

Possibly the major feature of the capsule will be a screen or screens which will display "outside" information made up of combinations of radar, optical and radio information, plus instantaneous data from the computor. The instantaneous data would give a continuous indication of such data as distance and time to target or base, and best trajectory for maximum range. The decision controls used for speed changes and displacement in space would be push buttons—"Up or down," "there or back," "go to position X," and so on.

Eventually a day might come when designers reach a stage at which it is no longer a practical proposition to continue to handicap aircraft design by having to make provision for a human pilot. Should that happen, then aviation as it has been known and thought about since the time of Leonardo da Vinci will become a very different subject about which to write.

ROLLS-ROYCE AUSTRALIAN CHANGES

CHANGES in the Board of Rolls-Royce of Australia (Pty.), Ltd., have been announced. Lord Hives, Mr. A. Harvey-Bailey and Mr. P. Birch relinquished their appointments on January 11 and their places on the Board are being taken by Mr. Whitney Straight (deputy chairman, Rolls-Royce, Ltd.), Mr. F. T. Hinkley (general manager, sales and service, Rolls-Royce, Ltd.), and Mr. W. P. Calvert. Mr. Calvert is also appointed general manager of Rolls-Royce of Australia (Pty.), Ltd., and is due to travel to Australia in the near future to take up his appointment.

Mr. W. P. Calvert.

The new general manager has had a long career in the aircraft industry. He was apprenticed at the Royal Aircraft Factory, Farnborough (now the R.A.E.), and was present during Col. Cody's pioneering adventures; he qualified as an R.F.C. pilot in 1918; in 1920 he joined the pioneer British airline, Air Transport and Travel, Ltd., at Hendon; subsequently he was associated with K.L.M., Daimler Airways, Fokkers and D. Napier and Son, Ltd., where he helped in the preparation of the Lion engine in the Gloster seaplane for the 1927 Schneider Trophy Race and was responsible for the installation of the Napier engine in the *Golden Arrow* car and the motor-boat *Miss England I*.

Mr. Calvert joined the Rolls-Royce service department in 1937, later became chief aero service engineer and subsequently manager of the aero service department, which he built up.

GEE AT SEA

RECENTLY, A. C. Cossor, Ltd., completed sea-going trials to determine the Gee range performance available to surface craft in coastal areas covered by Gee chains. The General Steam Navigation Company's m.v. *Ringdove* was equipped with a standard Mk III receiver and the trials took place over the vessel's normal route, London-Bordeaux. At Belle Isle (47 deg 20 min N, 3 deg 10 min W), 200 n.m. from the south-western Gee chain, an accurate fix was obtained, across 70 miles of France. The trials, it is stated, showed that accurate fixes at sea level can be relied on up to ranges of 200 n.m. from coastal sited Gee stations.

CL-28

Some Notes on the Largest Aeroplane Yet Built in Canada

ON December 28 the Canadair Division of the General Dynamics Corporation completed the erection of the first CL-28 long-range maritime patrol aircraft for the Royal Canadian Air Force. The impressive machine was towed from the end of the final assembly line at Canadair's Plant 1 at Montreal and is now in the recently extended pre-flight hangar. After being fully equipped, having a detailed weight check and completing vibration testing the machine is to fly early in the spring.

As we have often reported, the CL-28 is based on the Bristol Britannia. It is, however, an extensively redesigned aeroplane and many of its features are of uncommon technical interest.

Since the war ended in 1945 the defence of Canada has posed many weighty problems, which have been accentuated by Canada's generosity in supplying a degree of fighting strength to NATO quite out of proportion to her population. One of the most pressing difficulties has been to ensure that no possible aggressor could disrupt the sea routes leading from the Dominion's Atlantic and Pacific coasts. Patrolling these routes has been a major task of the R.C.A.F. Maritime Air Command, and valiantly have the crews of this command ranged far and wide over vast expanses of friendless and freezing ocean in their Lancaster MR.10s.

Nevertheless, by 1953 the beloved Lancs were showing their age. It was increasingly apparent that something better would have to be provided—something in which a crew could fly for 25 or 30 hours without becoming unduly fatigued, and which could also carry the most modern search and attack equipment. It was appreciated from the outset that the ideal aircraft would be exceptionally large; piston engines would be mandatory to confer great endurance at low levels, a big, high-lift wing would be essential to get the weight of fuel and military gear off the ground and the fuselage would need to be capacious and comfortable.

Development of such an aeroplane is an expensive business and it was logical that the Canadian Department of Defence Production should minimize cost and time by choosing as a basis an existing, fully developed transport aircraft. There were several possibilities. Finally, well into 1953, the choice hardened on the Bristol Britannia. It was realized that conversion of such a machine would be a tremendous undertaking, but the Britannia had unmatched attractions in its combination of a modern and lightweight structure, large internal tankage, a simple and effective flight-control system and many other advantages which bring no small credit to the original Bristol design team.

By the end of 1953 the die was cast (figuratively, if not yet literally) and the following April Canadair were given responsibility for the project—as the CL-28—with an initial order for thirteen aircraft. Since that time Canadair's work has been outstandingly well planned, as befits a division of one of the world's largest industrial organizations. The Montreal plants employ about 9,000 and occupy some 2.6m square feet of floor area. Plant 2, on the far side of the airfield, is gradually coming to the end of the long and prolific lines of F-86s and T-33s, and the contract for the giant ocean-patroller has been Canadair's biggest stake in the future since the small jets began to "taper off."

It is, in fact, not surprising that the company have kept most of the CL-28 work to themselves. Apart from the "systems," powerplants, undercarriage and military equipment, Canadair have designed and are manufacturing virtually the whole aeroplane. This is a unique state of affairs in the modern Canadian scene, where most projects are shared by several firms. Like Britain, the Dominion is suffering from a progressive "stretch-out" in military procurement, and Canadair are adopting a long-term viewpoint with the CL-28. In fact, as the orders have progressively increased so have the company stretched their programme to ensure that the production line will not suddenly run out.

Bristol Aircraft and Canadair have co-operated closely on the CL-28 project since its inception. Early in 1954 a flood of Britannia drawings, which eventually numbered thousands, started to flow from Filton to Montreal, and Canadair's D.O. staff began to appreciate the magnitude of the task facing them. After studying the British turboprop airliner in detail—to see, as one Canadian put it "what sort of an animal they had chosen to live with"—months were spent in Americanising the design (or perhaps it would be more precise to say "Canadianising").

Every sheet-gauge, every rivet and every screw-thread had to be converted to its nearest safe transatlantic equivalent. Material specifications had to be found to correspond to those employed in the British aeroplane, and machining and other operations had to be programmed in detail—including a host of procedures quite new to Canadian aviation. By no means least, sub-contractors and material suppliers had to be found, and their deliveries geared to the final production schedule.

Roll-out on December 28; note the fin-slot cut in the hangar roof.

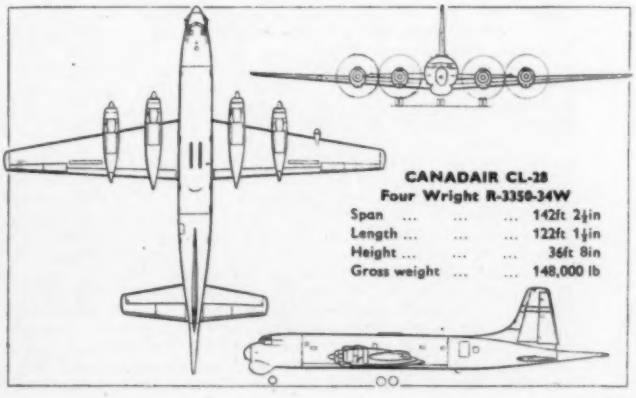
No alterations were countenanced without a really good reason, and substantial areas of the CL-28 are—except for the aforementioned naturalization—identical with those of the Britannia. In particular, the wing, flying controls and tail are essentially unchanged. The fuselage, however, is entirely different.

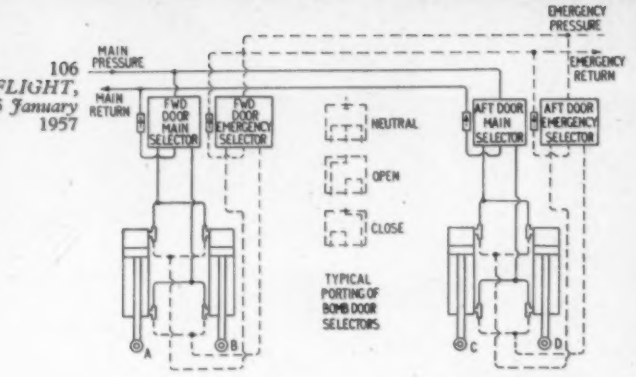
To begin with it is unpressurized. Apart from the task of radar picket, or high-altitude early warner, none of the missions of the CL-28 requires high-altitude ability; in fact, the reverse is generally the case. Deletion of the pressurization has allowed appreciable weight-savings, and the more one studies the CL-28 the more it becomes apparent that Canadair have gone all out to save inbuilt weight. Quite considerable effort has been expended in order to prune off an ounce here and an ounce there, and, as will presently be described, certain design changes have lopped off hundreds of pounds.

Nevertheless, Bristol's original airframe design is so efficient that the CL-28 parallels it closely. Changes introduced as a result of deleting the pressurization are minor, although simplification and a reduction in the weight of soundproofing has been made possible by the great reduction in fuselage window area. A major change, however, was required in order to carry the necessary operational equipment and weapons.

There are two weapons bays, separated by the wing torsion-box, which passes straight through the fuselage. Major loads are carried past the bay cut-outs by boundary longerons. Each bay has conventional outward-opening doors actuated hydraulically by jacks designed and produced by the Fairey Aviation Company of Canada. No details of the offensive load may be published, but it is certain to include every available type of sonobuoy, mine, depth-charge, A/S. bomb, homing torpedo, air-to-surface missile (such as Petrel) and similar maritime devices, as well as new weapons, now under development, which promise to revolutionize A.S.W. techniques.

Possibly no other aeroplane is quite the equal of the CL-28 in the matter of electronics. No fewer than 21 distinct radio or radar installations are standard, the most prominent being the search





Bomb-door circuit in the new 3,000 lb/sq in hydraulic system.

Main undercarriages are delivered from Jarry Hydraulics Division.

CL-28 . . .

radar mounted in the chin position. The latter is a particularly good location for such equipment and the general arrangement is similar to that used on the Shackleton MR.1 (although the equipment is more powerful on the Canadian aircraft). Another very obvious item is the MAD (magnetic airborne detector) installation housed in the "sting" fairing at the rear end of the fuselage. There are many other dielectric areas and the whole upper part of the vertical tail is structurally isolated to act as an aerial. It is probable that a receiver for Sarah will also be fitted (made under Ultra licence by Canadian Aviation Electronics). In addition, Computing Devices of Canada have developed ANTAC (air navigation and tactical air control) specially for the CL-28; it is likely to prove a development in instrumentation of great significance.

Wing and tail structures do not greatly differ from those of the Britannia (described in detail on July 6 last). Fuel capacity is 6,800 Imp. gal, compared with 6,670 in the Britannia 102 and 8,486 in the Britannia 312. The fuel is 115/145-grade petrol and it is contained in inter-spar bags. De-icing is effected by hot air from Janitrol heaters, of which there are two in the fuselage (on each side of the forward weapons bay) and one in the tail section to heat the empennage (Napier Spraymats are on the elevator horns). The bonded secondary structure in the leading edges employs FM.47 in place of the British Redux.

As already noted, the flying controls are generally similar to those of the Bristol machine. There is one major change, introduced to meet the requirements laid down for high rates of roll, particularly during attack operations at fairly low airspeeds. The three-view drawing shows the position occupied by the small spoiler on the upper surface of each wing immediately outboard of the outer nacelles. There is much to be said for such surfaces, actuated asymmetrically by application of heavy aileron deflection. Each spoiler has to flick fully up in about 0.6 sec, a factor which complicated the design. Similar surfaces are used on the Neptune.

Flap geometry is very like that of the Britannia. An appreciable saving in weight (some 25 lb) has resulted from the use of ball-bearing screw-jack rams (now used throughout N. America) which greatly reduce the required flap-motor torque.

Perhaps the greatest single difference between the Britannia and the CL-28 is that the latter is powered by Wright Turbo-Compound piston engines. The turboprops of the airliner, although very efficient at high speeds and altitudes, could not approach the economy of the piston engine for long patrols at low levels.

Each engine is an R-3350-34W, rated at 3,500 h.p. without water, and driving a 15ft 6in Curtiss electric three-blade propeller. Much of the firewall and nacelle structure is of titanium alloy (it has a darker appearance than the polished aluminium-alloy sheet used elsewhere) and it is calculated that on each CL-28 a total of 600 to 900 lb of titanium does the work of 1,800 to 2,700 lb of stainless steel. Canadair built a special outdoor test stand for the complete powerplant installation in 1955, and over 250 hours had been completed on this by last October. One of the programmes was a sound-measurement investigation, in which a test section of CL-28 fuselage was placed in the correct relative position beside the propeller of the ground-running rig. Noise is an important factor in an aircraft with great endurance and the CL-28 is very well soundproofed.

One incidental advantage of the switch to Turbo-Compounds is that there is no jet pipe in the CL-28 nacelle. As a result the bogie on each main undercarriage leg does not have to fold through more than 60 deg with respect to the leg. In the Britannia the bogie has to fold completely flat, requiring a special auxiliary hydraulic jack; the reduced movement in the CL-28 bogie can be introduced mechanically by a simple coupling linking the main radius rod to the upper half of the anti-shimmy scissors. The resulting elimination of jacks and sequence valves has saved 12 lb on each unit.

Jarry Hydraulics was the go-ahead firm which won the contract for the CL-28 main gear (and for the hydraulics, of which more is said later, as well as the feel simulator and flying-control locks), and they completed the first set of main-undercarriage units five months after producing final drawings. The steerable nose gear differs from that of the Britannia in retracting to the rear, by Fairey jacks. This change was necessitated by the proximity of the search radar, which has also forced Canadair to adopt a complex door arrangement. The outer doors covering the nosewheel bay are lightly built fairings incorporating the rear portions of the radome. The inner doors, which are tied to the lower set by linkages, are very strong and are structurally capable of standing up to water impact during ditching.

In the hydraulic system—by Jarry—the operating pressure is 3,000 lb/sq in. Although the component and pipe weights are inevitably greater (by some 21 lb) than those in the 4,000 lb/sq in system of the Britannia the penalty has been accepted in order to use available American or Canadian components. Each engine drives a Sundstrand constant-speed unit through which shaft-power is taken to drive the main alternators and, on the inner units, the two hydraulic pumps.

Both pumps are by Vickers, Inc., and have an output of 8.5 gal/min. Services supplied include bomb doors (a line diagram clarifies the bomb-door circuits), flaps, control locks, steering, undercarriage and wheel-brakes. All components are exceptionally easily maintained; the main circuit panel is on the rear face of the forward weapons bay and the panel for the electrically energized emergency system is on the rear wing spar, both panels being accessible in flight. The main reservoir is held at 12 lb/sq in above ambient pressure by a bleed from the armament pneumatic system.

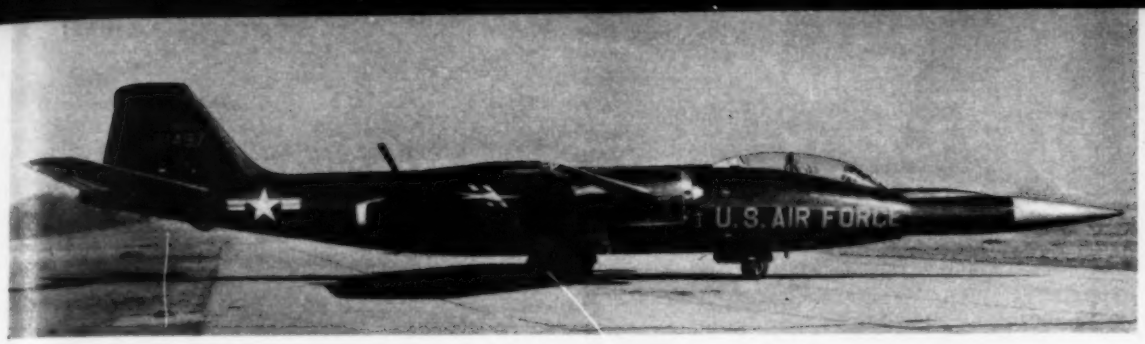
The four Sundstrand-driven alternators are each rated at 40 kVA and they supply a fully paralleled automatically controlled and protected system generating three-phase power at 208/120 volts. The D.C. system works at the conventional 28 V and the battery-supplied emergency system feeds loads at 115 V, three-phase. An exceptional proportion of the total electric power is utilized by the avionic systems, with precise frequency control.

Provision is made for a crew of 15. The flight deck is arranged for two pilots, with duplicated controls, and is spacious and comfortable. Owing to the absence of pressurization loads the windows are very large and deep. Each pilot has a conventional wheel-type control on a vertical pedestal, in contrast to the ram's horns of the Britannia. The autopilot is the Bendix-Eclipse PB-20. A flight engineer's station is provided on the starboard side and there are multiple stations for radar signallers, navigators and observers. One of the latter sits in the low-level attack station in the transparent nose and there are dished observation windows at the rear. Full provision is made for galley and crew-rest installations.

Test rigs for the CL-28 systems have been built since 1954 and, in view of the sound basis upon which the whole aeroplane is designed, it seems very unlikely that any serious trouble will be met in the future. The presently completed machine—20710—is not a prototype but is the first off a true production line, from which succeeding aircraft will follow at regular intervals. Already several CL-28s are in final assembly and the second fuselage was delivered for static (destruction) testing as early as last October. When 20710 flies it will be complete in every detail, the auto-observers and other test gear being readily accommodated in addition to all operational equipment.

To the original order for 13 aircraft has been added a further batch of 12 and, last May, a "multi-million-dollar" contract reported to have raised the total to 50. Further orders may be expected from countries outside Canada; the CL-28 has already been evaluated by the U.S. Navy and it may well find a place in the R.A.F. Coastal Command. Operational service with the Maritime Air Command of the R.C.A.F. is scheduled for next winter.

In conclusion reference should be made to the CL-44, a transport development of the CL-28 powered by advanced turboprops and fitted with an airline-type pressurized fuselage. Design studies, with either Bristol Orion or Rolls-Royce Tyne engines, have reached an advanced stage, and Canadair may well receive orders both from the R.C.A.F. and civil operators.



This Martin B-57B is the Temco-converted test-bed for the Boeing Bomarc, and was first illustrated in "Flight" of January 4. On the left is a Catalina of No. 333 Squadron of the Royal Norwegian Air Force (see paragraph on this page).

AIRCRAFT INTELLIGENCE

France

Marcel Dassault Super Mystère. The first production model Super Mystère B.2 fighter will be completed by the end of this month. Production rate will thenceforth work up to fifteen a month. Construction of Super Mystères is divided among several companies—Marcel Dassault at Argenteuil (fuselage), Sud-Est at Toulouse (fuselage), S.N.C.A.N. at Bourges (wing), and Marcel Dassault at Talence (tail unit). Final assembly is undertaken at Bordeaux-Merignac by Marcel Dassault.

*S.E.*3130 *Alouette II.* Production of this turbine-powered helicopter, described in *Flight* of November 30 last, is now in full swing. By the end of last year thirty-two had been accepted by the Government and production rate was thirteen a month. Sud-Est have set themselves a goal—to sell and deliver at least 500 Alouettes for the domestic market and for export.

Switzerland

Pilatus P-3. At the Pilatus works at Stans construction of fifty P-3 trainers is in progress. The aircraft will be supplied to the Swiss Air Force in replacement of Bu 131 Jungmanns, Bu 133 Jungmeisters, Pilatus P-2s and North American AT-6 Harvards. As in the British Provost/Vampire scheme, pilots trained on P-3s will pass on to Vampire Trainers.

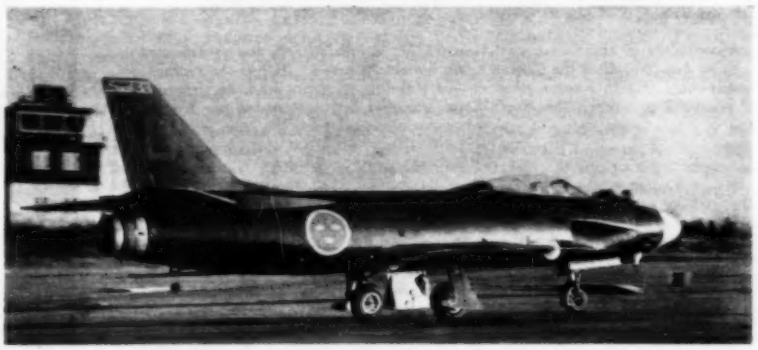
Norway

Consolidated Catalina. In forwarding the photograph of the Catalina reproduced on this page, an officer of No. 333 Squadron, Royal Norwegian Air Force, notifies us that the unit celebrates its 15th anniversary on February 8. Formed in Scotland, it was first called "Norwegian Detachment, Woodhaven." Initial equipment was two Catalinas. Later it became 1477 (Norwegian) Flight, and got another Catalina, but not until May 10, 1943, was it officially designated No. 333 Squadron. Later, Mosquitoes formed a second flight. Having reformed in Norway after the German capitulation, the squadron now operates Catalinas only—on M.R. and A.S.R. duties.

Netherlands

Air Force Equipment. The year 1956 was an important one for the Royal Netherlands Air Force. All Thunderjets of the tactical squadrons were replaced by Thunderstreaks and Thunderflashes. The first Meteor squadrons were re-equipped with Hawker Hunters and 20 Hunter T.7 trainers were ordered. The first of these is to be delivered in March next. Three all-weather squadrons were formed with F-86K Sabres and the Fokker S.14 Mach Trainer came into service. Dutch naval pilots flew from the British carrier H.M.S. *Bulwark* on training flights, and out of 15 Martin Mariner flying-boats ordered eight were delivered from the U.S.A. by Dutch pilots. Hawker Sea Hawks are expected this year to replace the present Sea Furies.

Kolibrie Helicopter. The fourth prototype of the Kolibrie helicopter—an H-3—is now almost ready and will replace the H-2, which is to be retired. The third prototype—also an H-3—was completed last November. The Kolibrie is now being tested with a spray boom for agricultural work, and a special so-called "helicar" has been designed for inter-farm transport. First deliveries for Holland and for export are expected this year. Four Kolibries are to be shipped to Dutch New Guinea.



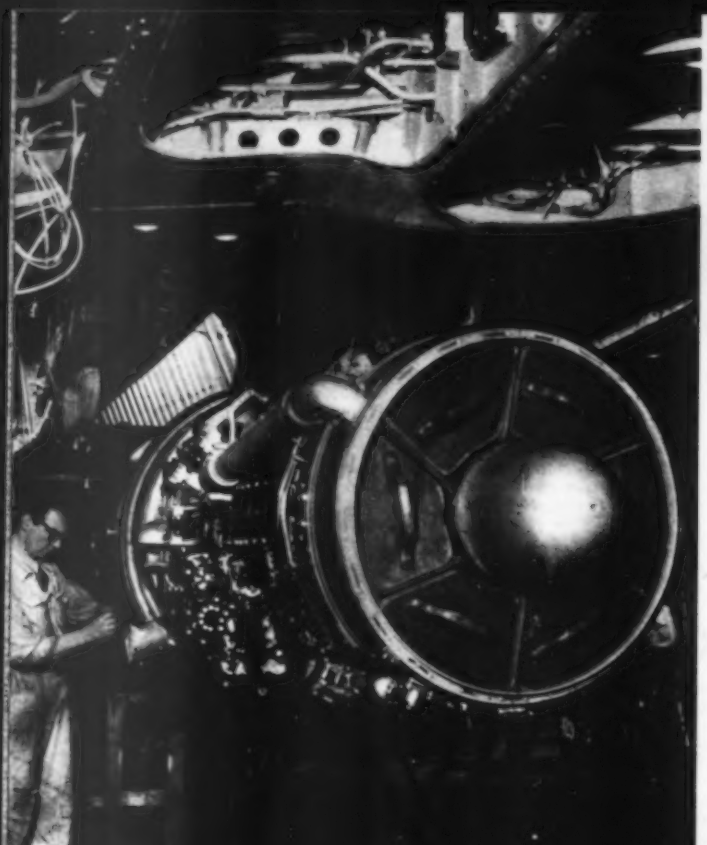
The upper view of the Saab J 32B Lansen all-weather fighter, shows the larger afterburner. The first view of the J 32B appeared in last week's issue of "Flight." The close-up picture shows a Northrop Scorpion, having a Vulcan six-barrel 20 mm gun mounted vertically to provide data on cross-wind ballistics. The experiment is connected with the arming of the Hustler supersonic bomber.

"Comet 3½A" Powerplant

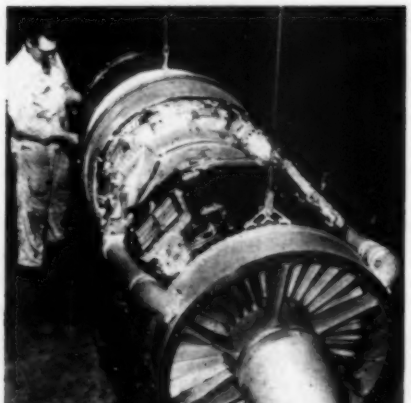
ONE of the numerous changes being made to the Comet 3 prototype in order to bring it up to Comet 4 and 4A standard is the replacement of its Rolls-Royce Avon RA.26s by the higher-powered (10,500 lb st. thrust) Avon RA.29s. This change has involved extensive re-engineering of the engine bays and—in particular—of the air intakes.

The converted Comet 3 (nicknamed Comet 3½A) should fly in three or four weeks' time with its new engines, and with other changes which will make the aeroplane as representative of the 4 and 4A as possible. These include: (1) the fitting of detachable outer-wing panels, to permit flight-test evaluation of the 7ft-shorter-span Comet 4A; (2) the installation of an automatic pressurization and air conditioning system (see *Flight* for July 6, page 29), and noise-reducing refinements to the distribution and recirculation; (3) modification of the electrics so that power is distributed by split bus-bars (July 6, page 29); (4) structural provision on the engine jet-pipes for reverse-thrust and engine silencing; (5) the embodiment of q-feel in the elevator control circuit.

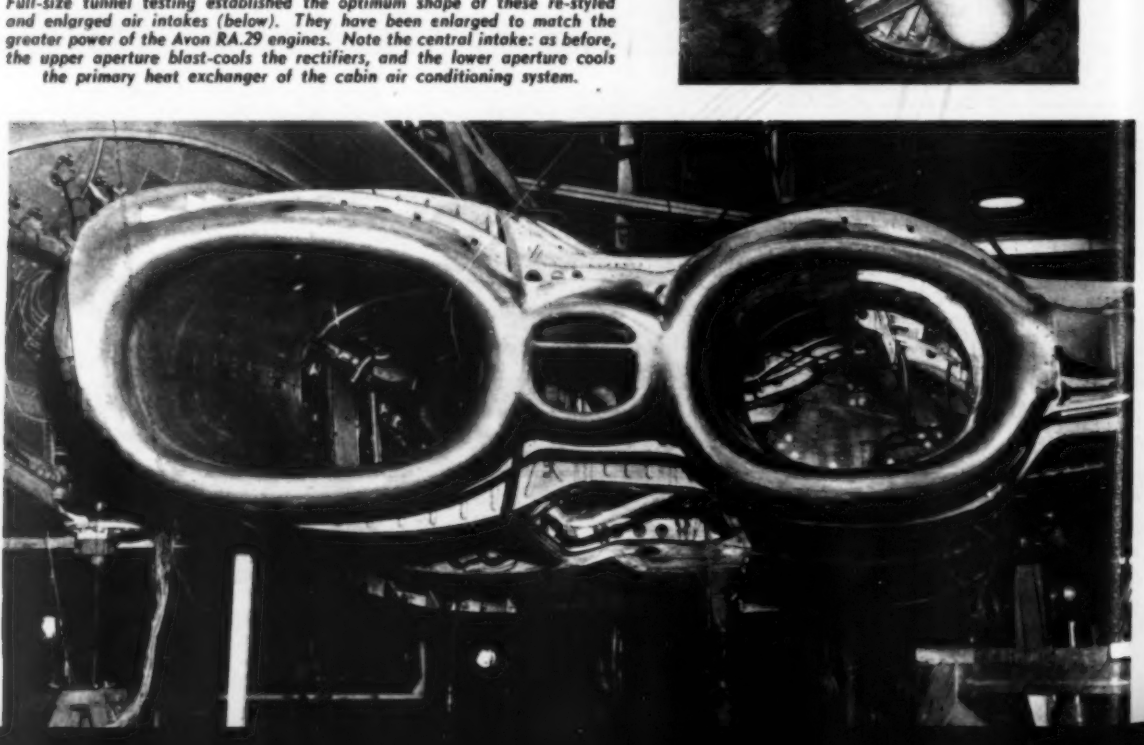
With the "Comet 3½A" de Havilland intend to complete a large part of the flying programme for A.R.B. and American C.A.A. certification before the first production Comet 4 flies later this year. On the engineering and technical side A.R.B.'s requirements have, the company states, been met: C.A.A. requirements—at least those so far made final—appear to present "no insurmountable problems."



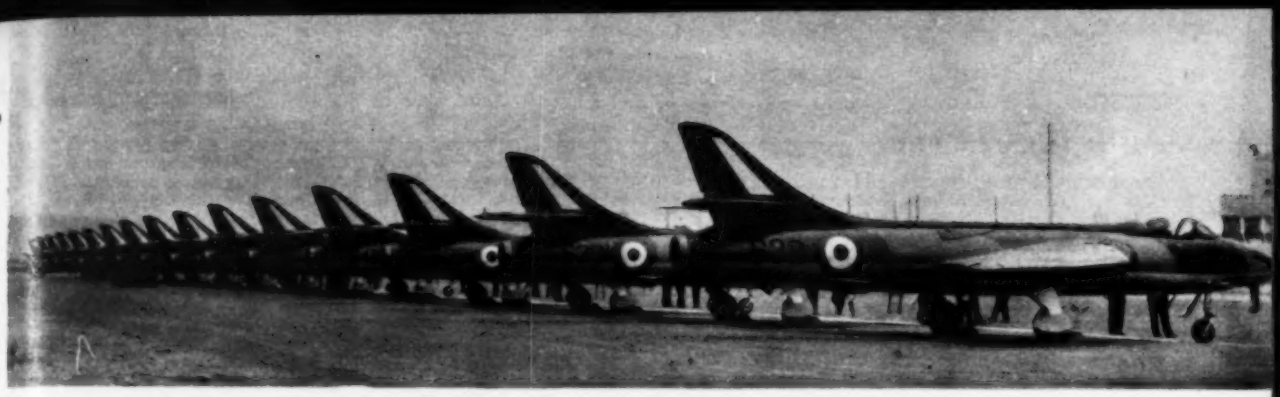
(Above) One of the brand-new Avon RA.29s is hoisted into the refashioned engine bay (No. 3) of the Comet 3. An important modification is the replacement—in line with modern practice—of stainless steel fire-walls by titanium. The outlet pipe near the man's hands supplies hot compressed air for the airframe de-icing.



(Right) The first photograph to be published of a production RA.29 Avon. Points of interest include the large de-icing air pipes (kinked to avoid the front mounting points) and the cabin-air manifold at the rear.



Full-size tunnel testing established the optimum shape of these re-styled and enlarged air intakes (below). They have been enlarged to match the greater power of the Avon RA.29 engines. Note the central intake: as before, the upper aperture blast-cools the rectifiers, and the lower aperture cools the primary heat exchanger of the cabin air conditioning system.



Hunter 52s of the Peruvian Air Force. Camouflage is grey and green, and the flash and roundel colours are red/white/red.

HUNTERS IN PERU

An Account of Their Assembly and Early Flying

ONE of the features of the inauguration ceremony of 14th Fighter Group of the Peruvian Air Force was a formation fly-past by three Hawker Hunters. A common occurrence —but with this difference: the aircraft were piloted by Peruvians who had never flown Hunters in formation before.

The incident (runs an account in the *Hawker Siddeley Review*) was typical of the fast work and initiative of the Peruvian Air Force in bringing their new Hunter 52s into service. With the aid of five engineers from Hawker Aircraft, Ltd., under the charge of Mr. L. W. J. Hersey, the Hawker assistant service manager, and a representative of Rolls-Royce, Ltd., they assembled sixteen aircraft in the space of 20 weeks. Mr. D. M. S. Simpson, A.F.R.Ae.S., Hawker test pilot, went to Peru to deal with all flying questions and, incidentally, provided all the information on which this article is based, together with the photographs.

This was the first occasion on which Hunters had been shipped overseas since those delivered to NATO countries were assembled in Britain and flown to their new owners. There were, inevitably, difficulties. The aircraft were new to the Peruvians, and the assembly line was a stretch of tarmac, with an open-fronted hangar to house the stores organization. The crates in which the aircraft had been delivered had to be pressed into service to make benches and shelves for the stores.

The policy followed was to open the cases and leave the broken-down units of the aircraft on the wooden formers in their cases until such time as the team was ready to assemble them in their correct sequence. By this method the team-members were able to conserve their limited supply of ground equipment and at the same time carry on assembling the units. This applied more to the rear fuselage than any other unit. It was possible to assemble the fin, rudder, tailplane and elevator to the rear fuselage while it was still on the ground and the only time the rear fuselage trolley was used was when the rear fuselage complete was offered up to its aircraft.

Assembly proceeded on the first six in such a way that it was possible to lay down a production line principle and one or two men, whatever the operation called for, were able to follow through the same operation on all sixteen aircraft.

The Hawker team were gratified to report that no major defects were encountered on any test flight and the majority of aircraft were passed off on the two flights called for under the test-flight procedure laid down. But they were even more pleased to know how smoothly Hunters can be assembled under unorthodox conditions—provided the people doing it are as energetic and skilful as the Peruvians.

The first six Hunters arrived at Callao in the third week of February 1956 and were taken by road to Limatambo Airport. A second shipment, of four aircraft, arrived at the airport on March 21 and 22. Yet by April 15 four of the Hunters were ready for testing and the remaining six were completely assembled and undergoing final inspections.

The first flight from Limatambo took place on April 18—watched by the Air Minister and senior officers of the Air Force. It was a critical moment. Limatambo is essentially a civil airport and the loose gravel surface of the runways was hardly ideal for jet aircraft, although the length of 2,000yd (2200 m) was adequate. Both runways were flanked on either side with a flourishing cotton crop, and the undershoot and overshoot areas had their share of obstructions, including a ten-feet high brick wall at one end. But through the excellent co-operation of the civil controlling staff, the programme of flying the Hunters proceeded smoothly.

Work did not stop with the final flight tests of the aircraft; Peruvian crew had to be trained to fly them. Before training began, six officers of the newly formed 14th Fighter Squadron translated the Hunter manuals into Spanish. The final result, produced in just over two weeks, was a beautifully finished flying manual, covering not only pilot's notes but instruction on equipment and powered flying-controls. Although Mr. Simpson gave lectures to the Peruvian pilots, most of whom spoke English fluently, it was found more satisfactory to run through each lecture in detail with their commanding officer and let him answer questions in the pilots' own language.

On May 22, Peruvian pilots made six flights in Hunters, led by the Group Commander, Col. Fernando Paraud, who had previously flown a 20-minute sortie in a Hunter at Dunsfold. He and his colleagues Major Leon Melgar and Captain Thorndike (the squadron commander and senior pilot) very soon completed the conversion course and later flew each aircraft on an official acceptance check.

The only feature of Peru which disappointed the British was the weather. From the beginning of May onwards the sun was obscured for most of the time by a cloud layer extending up to about 3,500 to 4,000ft (1050-1200 m). Owing to the temporary absence of radio compasses in the aircraft, instrument let-downs were made by a method worked out in discussion with the senior Peruvian pilots, and which was in fact safer than it sounds. Flying above the clouds the procedure was to set course from one of the Andes foothills known as Cerra Colorado, the top of which was 8,000ft (2400 m) above sea level. A standard pattern was then flown and an overhead position at Limatambo was cross-checked by the relative position of three other known mountain tops and from a portable D/F. radio set, most professionally operated by

Details of a Hunter gun-pack being explained to the President of Peru, Gen. Manuel A. Odria, and senior officers of the Peruvian Air Force.

HUNTERS IN PERU . . .

one of the Hawker engineers. In practice the D/F. set was subject to various inherent failings, whereas the mountains were noted for their reliability. It need hardly be added that to make full use of the latter facility one required a good knowledge of the local Andes! From the overhead position, the pattern was confirmed and contact was made about five miles (3 km) off the coast. The method proved very accurate owing to the light south-westerly winds prevailing and worked well in conjunction with civil approach procedure.

The last six aircraft had meanwhile arrived at Limatambo on May 5, and by uninterrupted work were made ready by the 30th, the day on which the inauguration of 14th Fighter Group took place. In the first week of June it was decided to begin training the squadron pilots. The aim was to have them flying the Hunters in a fly-past on the traditional National Day celebrations on July 29. It was certainly a formidable one.

Each training sortie was carefully planned in advance, and the pilot received a printed card bearing full information on the conversion flight he was about to undertake. The programme was planned each evening for the following day, and amended according to the weather if necessary. At an early morning briefing the senior pilot explained each day's flying programme and discussed with the pilots under instruction any problems from the previous day. In addition squadron pilots were chosen at random to explain one flight emergency at each briefing. A "chase" aircraft flown by Col. Paraud, Major Melgar or Captain Thorndike, accompanied each pilot on his first and second flights, so that the less experienced aviators could concentrate on flying the aircraft rather than on the "Cerra Colorado" let-down which was usually needed at the end of the flight.

On June 7 a squadron pilot made his first solo; by mid-July all the pilots had completed their conversion courses and begun formation training. Despite the difficult conditions the entire task of conversion was accomplished at the negligible expense of one tail bumper. A more serious accident occurred during formation flying when the wing tips of two aircraft touched. Both aircraft landed safely, however, with damage confined to the port wing of one and the starboard wing of the other, and by putting both intact wings on to one aircraft, it was possible to fly fifteen of the Hunters in the fly-past. Although they had only two or three hours' formation flying in their Hunters, the Peruvian pilots led the fly-past in a box formation which was first-rate, judged by any standards.

The fly-past passes over the centre of Lima, where the armed forces are reviewed by the President of the Republic in the Campo del Marte. This year's National Day was especially significant as it coincided with the election of the new President, Dr. Manuel J. Prado. During the eight years of office of the outgoing President, General Manuel A. Odria, the Peruvian Air Force had been re-equipped with the most up-to-date British and American jet aircraft, and those which took part in the National Day celebrations left no doubt of the capabilities of the Peruvian pilots. The day after the fly-past the press contained the text of a telegram of congratulation sent by Air Chief Marshal Sir Dermot Boyle, Chief of the British Air Staff, to the Peruvian Air Minister.

By July 11, the last aircraft had been handed over to the Peruvian Air Force. Some two weeks later four of the Hawker engineers bade farewell to Peru, the fifth remaining as the firm's representative. Their achievement was one of which they might well be proud. Sixteen aircraft had been assembled in four and a half months, under conditions which were far from ideal. The work had been done in the open air in anything from tropical heat to cold heavy drizzle.

Equal credit is due to the civilian engineers from the Peruvian Air Force arsenal, who were drafted in to assist in the work. The facilities of the arsenal were placed at the disposal of the British engineers for any repairs that were necessary. No job, however small or large, was beyond their capabilities and the standard of workmanship was of the highest order. The commandant, Colonel Jorge Vigil, and the liaison officer, Captain Victor Ortega, always proved able to meet the numerous and often seemingly impossible requests for materials and specialist engineers. The knowledge gained by these technicians during assembly will stand them in good stead in the future.

Language difficulties, resulting from the British attempts to learn Spanish and the Peruvians simultaneously learning English, did not present any problems which spontaneous good humour on both sides could not solve. The co-operation between both parties resulted in trouble-free test and service flying which is a credit alike to the Peruvian civilian and service engineers and to the Hawker and Rolls-Royce team.

The Hawker team were greatly encouraged by the way in which the Peruvian pilots flew their Hunters. On his return to this country Mr. Simpson said: "One did not need to know the language to realize their enthusiasm over their new aircraft. To have worked with them was indeed a pleasure, and we look forward to hearing more of them in the future."

THE "VANGUARD" SATELLITES

SOME of the observations that might be carried out with the aid of the first few small artificial satellites to be launched in the American "Vanguard" programme formed the subject of a talk by Dr. Michael Ovenden, lecturer in astronomy at Glasgow University, to the British Interplanetary Society on January 5.

The lecturer showed that even without internal instrumentation the satellites could provide a great deal of data. Perhaps the most important job that the early vehicles could do would be to provide information on the density of the atmosphere at very great altitudes. Curiously enough, aerodynamic drag would cause the satellite to spiral in towards the earth and, initially at least, to increase its speed. The amount by which it fell towards the earth could be used to calculate the aerodynamic drag and hence the density. Dr. Ovenden gave figures showing the approximate amount by which the height of a satellite in a circular orbit would be reduced per revolution round the earth. These were based on

Altitude (miles)	Reduction in altitude (miles/revolution)
300	0.01
250	0.02
200	0.10
150	0.65
120	4.70
100	33.00

our present scanty knowledge of the properties of the upper atmosphere, but they did show that by the time the satellite reached the 100-mile level its life would be almost at an end. It was in the final few revolutions of the earth that the amateur network of observers would prove to be most useful. At this time the batteries in the satellite would be exhausted and the rapid changes in the orbit would militate against the use of the Schmidt recording telescopes. Thus the collection of drag data would largely depend on amateur observations.

Various geodetic data could also be obtained by orbital observations only. For example the earth's shape and size were not exactly known; surveys started from various points on the surface could not be made to fit together exactly. The survey from America did not line up with that from Europe by about 100 yards. Simultaneous observations of the satellite should enable this error to be reduced to not more than 50ft.

It was well known that the earth was not a perfect sphere, but the amount and exact distribution of the equatorial bulge were still not known to any high degree of accuracy. The satellite orbits were to be ellipses and by measuring the rate of progression of the apses of the orbital ellipse the exact shape of the earth could be determined.

One of the more important long-term results of satellite observations would be the more accurate determination of weather trends. Although the heat input to the earth was fairly accurately known the outward radiation was not—this knowledge would greatly help the meteorologists. A simple photometer could give this information. At the same time this instrument could be used to solve one of the mysteries of the universe—the distribution of the galaxies. According to current theory the night sky should be uniformly bright, not black; and, indeed, with almost any conceivable distribution of the stars the temperature at the earth should be about 6,000 deg K! A measure of the background radiation in space could help to solve this paradox. J. H.

UNDERSTANDING NOISE

THERE is to be another course on acoustics at Southampton University in 1957, from April 1-6, on similar lines to one held there during April 1956. Designed for people with no preliminary knowledge of acoustics, the course is intended chiefly for workers in the aircraft and other industries, who have to deal with the increasingly important problems of noise. Emphasis is laid on the mechanism of noise generation, in order to give a thorough understanding of the behaviour of airborne noise; and together with a general background on the subject there are alternative advanced courses, one of the effect of noise on structures and one on noise measurement techniques.

The fee for the course is £21, including accommodation at one of the University halls of residence, and further details may be obtained from Mr. D. J. Mead, Aeronautical Engineering Department, The University, Southampton. Applications should be made not later than March 1, 1957.

Fiat's most important ventures—the licence-produced North American F-86K (right) and the Bristol Orpheus-engined G.91 ground-attack fighter, at the company's base at Turin/Caselle. The G.91 is markedly similar in outline to the F-86K. Noteworthy are the twin, under-fuselage airbrakes and the Martin-Baker Mk 4 ejection seat.

FIAT AVIAZIONE

The Aviation Division of Italy's Industrial Giant

By C. M. LAMBERT

THE aviation division of the Fiat company is responsible for no less than seven-tenths of the Italian aircraft industry's production; yet in size it accounts for a relatively small part of the great Fiat industrial organization producing motor cars, vans, lorries, railway rolling stock, industrial and marine engines and heavy and light machinery.

With the most up-to-date equipment and installations, the aviation division is at present producing both engines and airframes. It has fully made up the technical leeway of the immediate post-war years by the production, under foreign licence, of aircraft and engines of up-to-date structure and performance. The first indigenous fruits of these advances are to be seen in the G.91 ground-attack fighter, the G.82 jet trainer and in the type 4002 light turbojet.

The head office of the aviation division is at 200 Corso Giovanni Agnelli, Turin, which is also the site of one of the huge car factories and of some of the main offices of the whole organization. From here the work of Fiat's five aircraft and engine facilities around Turin is directed. At Caselle, Turin's modern civil airport, there are two establishments, one housing the flight-test department and the other the final assembly and overhaul of the F-86K and D respectively. It is at Caselle that the very interesting G.91 light fighter is being test-flown. Detail and sub-assembly fabrication is the responsibility of the factory at Stabilimento Valivoli (formerly called Aeritalia); and here the pre-production line for the 27 G.91s so far ordered is being set up.

Fiat have not been slow to develop a series of experimental establishments to enable them to support their production and design work. The flight-test department at Caselle is fully equipped to process and evaluate automatically recorded flight data; and a large testing facility at Sangone, for experimental engines and propellers of all kinds, was recently completed. A big new wind tunnel, thrust-measuring balances for complete aircraft and electronic laboratories for inspection of radio and radar equipment complete the experimental establishments.

The whole engine division is housed at Lingotto, where the factory is divided into two sections, one handling the overhaul of piston engines and the other jet-engine manufacture. The piston-engine section deals only with the overhaul, for military and civil agencies, of the Pratt and Whitney R-985, R-1830 and R-2800 and the Rolls-Royce Merlin 500. Propellers are also produced, based on a Hamilton Standard licence, the main types being the two-bladed model 5006 constant-speed unit for 200 to 300 h.p. engines, and the four-bladed model 5010 which is suitable for the Merlin.

A close link with the de Havilland Engine Company was formed some years ago when Lingotto began production of the D.H. Goblin for the Vampires which Fiat built for the Italian air force. For this purpose the latest equipment for production of the whole Goblin was installed and, when Sud-Est Aviation (then S.N.C.A.S.E.) took up the Sea Venom and developed it into the Aquilon, Fiat obtained the contract for producing 130 Ghost 48 Mk 1s for them. This work is now practically finished. Some Ghost parts were also produced by Fiat for de Havillands in England.

In 1953 came an American offshore contract for the overhaul and production of major replacement sub-assemblies for the Allison J35-A-29 engine which powered the F-84Gs issued to the Italian and many other NATO air forces. Lingotto produced, among other components, complete rotating assemblies for this engine, but J35 work is now virtually finished. When the licence for production of the North American F-86K was negotiated, Lingotto turned its attention to the General Electric J47-GE-17B engine and afterburner fitted in this machine. Production of parts and overhaul of complete engines is now getting under way. In addition Lingotto houses a U.S.A.F. bonded store for spare parts; it serves most of U.S.A.F. Europe with certain categories of spares.

The aircraft division, working on the F-86K, had not the necessary machine tools for milling integrally stiffened skin panels, and the engine division has been able to take this work over with comparative ease. The thick main inter-spar skin panels are first stretch-formed and the integral stiffening is milled on to the plate when it has a slight single curvature. When this process is complete, the whole panel is further bent to the required compound curvature. The engine factory also produces the metal pressings for external fuel tanks.

But the most significant venture of the Fiat engine division is the little 4002 turbojet, two of which have now completed over 100 hours of bench running in the engine-test cells at Sangone. It is intended for both military and civil light aircraft applications, and preparations are in hand for production. The designer's main aims have been to provide structural simplicity, for the sake of easy production and maintenance, and to reduce the length rather than the frontal area of the engine for ease of installation in small aircraft.

The 4002 is a reverse-flow unit with a centrifugal compressor giving a pressure ratio of about 4:1 at a mass flow of 11 lb/sec at 26,000 r.p.m. Total length and diameter are respectively 40.71in and 22.36in, and weight is 219 lb. Specific fuel consumption is 1.25 lb/lb thrust/hr and maximum thrust 550 lb at 26,000 r.p.m. The single-stage turbine has 57 blades mounted in fir-tree root fittings on a machined disc. Cast hollow guide-vanes, cooled by air bled from the compressor, are welded to the inner and outer rings of the turbine shroud. The engine oil tank is integral with the compressor casing, and all accessories are mounted ahead of the centrifugal section. Starting is by compressed air or electric motor.

Blade production is always a major item in jet-engine manufacture, and Fiat has now accumulated considerable experience of forging and machining these items. The technique mainly employed is to extrude the material and pass it through two heats and two forging blows to form a blade with a contour accuracy of 0.05 mm. Five broaching operations form the root-end; and

FIAT AVIAZIONE . . .

heat treatment, trimming and automatic polishing to micro-inch finish produce a completed blade.

Fiat's main airframe factory, the Stabilimento Velivoli, is on the edge of the old Aeritalia airfield, but since this field is too small for F-86Ks, final assembly and flight test were set up at Caselle, which has concrete runways and modern facilities. After World War 2 the piston-engined trainers G.46, G.49 and G.59 and the Vampires were built in the old factory; but for the F-86K brand-new buildings were put up to handle sub-assembly fabrication, this in addition to the large final assembly hall at Caselle.

Although as much floor space is now devoted to F-86K production in Turin as was used by North American at Los Angeles for the F-86D, the Italian rate of production has until recently been rather lower, because of the insufficient orders. Numbers of 86Ks are now on order both for the Italian air force and for other NATO countries. Germany has ordered 90 86Ks, and now production is rising past the ten per month mark. The first F-86Ks were recently delivered to the 13th Escadre of the French Air Forces 1er CATAC. At Caselle Nord, Fiat also overhaul American-built F-86Ds for U.S.A.F. squadrons in Europe.

In the production of the F-86K Fiat receives directly from North American such items as radar, radio, hydraulic components, fuel tanks, undercarriages, wheels and brakes. But virtually all the metal work for the airframe itself is done by Fiat and more and more components hitherto supplied from America are being produced by Italian companies.

Fiats have in several cases improved on American manufacturing techniques, and reduced production costs. The big hall where sub-assemblies are built is divided into four bays devoted, respectively, to small sections, wing components and control surfaces; complete fuselages; main wing panels and centre-section carry-through structure; and smaller systems-components. Electrical wiring is made up in harnesses on diagrammed jig boards ranged like drawing boards on a balcony overlooking the fourth bay.

In the first bay there is a considerable number of small jigs and here Fiat have introduced the use of pneumatic drills and riveting machines mounted on articulated arms like those of office desk lamps. Compressed-air power is used throughout and rigid airlines are laid along the floors with quick-connecting terminals at regular intervals. The various types of rivets are kept in distinctively coloured bins, some of them refrigerated. At the end of this bay, control surfaces can be seen taking shape on rather larger jigs. Here, too, the complete "slab" tailplanes and fins made by Macchi under sub-contract are unpacked and inspected.

In the second bay the engines are taken out of their sealed, gas-filled transport containers and the accessories are attached. The after-fuselage is assembled and the tail surfaces offered up. All equipment is then installed and electrical and hydraulic circuits tested. The fuselage forward of the normal engine-access break is built up in four or five blocks, that containing the cockpit, radar and engine air-intake being produced in one piece. Extensive use is made of rotatable jigs. North American themselves instal all electric cables in the completed fuselage, but Fiat put cable harnesses into each sub-section as it takes shape. This makes assembly and functional testing easier.

Finally, the two major fuselage sections are mounted in a large test-stand and all installations are again checked with the engine in place. The whole forward fuselage is then mounted on a special trailer by its wing attachment points, with the engine installed, and taken by road to the final assembly plant at Caselle Nord. The engine is anchored in the fuselage by its two main bearers and steadied by its attachment to the rail under the fuselage top-decking which is the integral installation gantry.

In the third bay of the hall the wing panels are built up, main units being the massive thick-skinned torsion boxes and the slatted leading edges, trailing edges, flaps and ailerons which are later added. The torsion box consists of the two main spars joined by the strongly reinforced upper and lower skins. The last-named are not in fact uniformly tapered in thickness, but contour-milled and reinforced by heavy, overlapping top-hat-section stringers to give the effect of a spanwise-corrugated inner skin. Free space is taken up by bag-type fuel tanks. The formidable task of drilling, countersinking and flush-riveting these main wing-skin panels is done by a tape-controlled automatic machine which traverses across the enormous bed on which each wing panel is held. This machine automatically deals with the very complex pattern of rivets. Each finished wing skin-panel is then bolted to the spar flanges and the whole wing is flange-bolted to the centre-section box.

The fourth bay of the F-86K production hall is, like the first, a centre of comparatively small industry. Here such items as canopies are assembled and prepared for passing to Caselle. While the Mareng fuel cells (they are identical in the F-86K and D) are still being supplied direct from America, the Italian Pirelli company has produced six samples which are now being evaluated in America. Undercarriages, wheels, tyres and brakes also

The F-86K assembly line at Fiat's Caselle Nord establishment. The upended wing which comes first on the line can be seen at the first station in the background, while complete aircraft take shape in the foreground. Below is the first prototype of the little G.91 fighter. The tailplane is a single-piece slab, the wing is very thin, the tyres are suitable for unimproved airfields and four guns are mounted in the fuselage flanks. A Bristol Orpheus engine and Martin-Baker Mk 4 lightweight ejection seat are fitted.

(Right) The little G.91 lands at Caselle with its twin airbrake surfaces extended. Fiat test pilot Signor Bignamini, who won the McKenna Trophy at the E.T.P.S. a few years ago, made the first flight last August.

(Below, right) A line-up of completed Fiat F-86Ks at Turin. The production rate is now rising past the ten per month level.

(Bottom) Fiat's jet trainer, the Rolls-Royce Nene-powered G-82, seen over the wing of one of the Merlin-powered G.59 operational trainers.

still come from America, but the Nardi company has a production licence and will begin manufacture under sub-contract if orders justify it. The electrical wiring harnesses are made up from measured lengths of identity-tagged cable with plugs ready attached. Each harness is tested before it is passed to the assembly line, tested again there, and finally rechecked immediately before the whole airframe is completed. The pilot-ejection seats are made by North American and sent direct to Fiat.

At the Caselle Nord establishment the sub-assemblies are joined together on fixtures moving on rails through the various assembly stations. First item on to the line is the wing carry-through box. The wing torsion boxes are bolted on and the main undercarriage units attached while the embryo wing is up on end, the tips high in the air and leading edge downwards. Fuel tanks are installed and tested and then the wing is laid flat and leading edges, slats, wing tips, trailing edges, flaps and mass-balanced and sealed ailerons are added. The fixed leading-edge is attached to the wing top skin by a piano hinge locked by three lengths of rod inserted with the aid of a pneumatic hammer. Panels in this structure give access to the aileron cables which run along the whole length of the forward face of the torsion box. At this point on the assembly line the pitot circuit is installed and tested with the aid of an Italian-designed mobile pressure-testing machine. At each station electrical wiring is tested for continuity, resistance and earthing, both in cables and plugs.

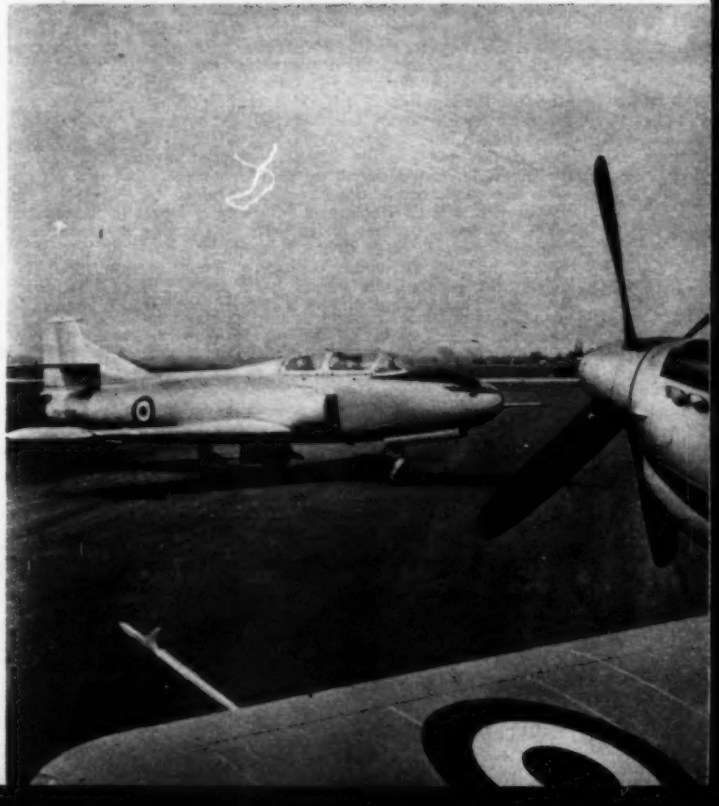
The wing then progresses to the station where the forward fuselage is lowered on to the carry-through structure and attached by its four massive retaining bolts. Systems in wing and fuselage are connected up and a further series of electrical and hydraulic tests are completed. The armament, consisting of four American 20 mm cannon, is installed in the flank of the fuselage.

The space in the under-fuselage which, in the 86D, is occupied by the Mighty Mouse rocket tray, appears to house electrical equipment in the 86K. There are two inverters producing 112 volts A.C., 400 c.p.s., from the generators' 24 volts D.C. supply; and both can be quickly lowered in their mountings from under the fuselage for inspection and maintenance. The batteries are in the after-fuselage and can similarly be lowered from their stowage on cables. A single pressure-refuelling nozzle is located in the fuselage just above the port wing trailing edge.

The rows of turbulators about the tail are variously made up of plain angle-pieces riveted to the skin; of long strips of metal from which turbulators are cut and bent up; and of machined or forged blades welded to the airframe skin. The autopilot and radar fire-control systems are supplied direct from America and accurately checked and tested at Fiat's Electronic Centre, which also takes care of the overhaul and repair of this radar for the Italian Air Force F-86Ks and those of other NATO air forces. The F-86K, like the D, uses stainless steel in "hot" parts of the after-fuselage where the later F-100s have titanium.

Completed F-86s are towed down to the flight test establishment on the south side of Caselle airfield for air testing prior to delivery. A number of 86Ks and G.82 Rolls-Royce Nene-powered trainers can be seen at Caselle airfield at any time and three test pilots are employed by Fiats to fly them. Signor Sanseverino is well known for his work in developing the G.80 and G.82 series and five of the latter have now been delivered to the Italian air force at the Amendola Jet Training School. Signor Marsan, chief test pilot, and Signor Bignamini test the F-86Ks, and the other Fiat aircraft (G.46, G.49, G.59 and Vampire), Bignamini also having been responsible for the first flight of the promising G.91 NATO ground-attack fighter last August.

Signor Bignamini is also well known in England for having won



The Bristol Orpheus engine which powers the G.91 and for which Fiat hold a production licence.

FIAT AVIAZIONE . . .

the McKenna Trophy in the 1954 course at the Empire Test Pilots' School at Farnborough.

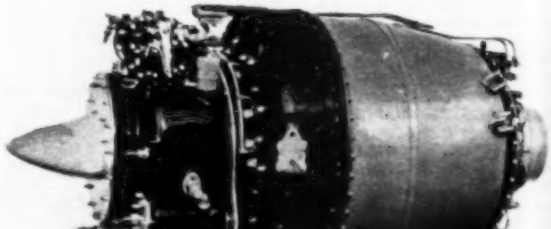
About the G.91 Fiat maintains the utmost secrecy. In fact all Fiat aircraft establishments are subject to strict security surveillance and though the aircraft was actually in a hangar at the time of my visit I was able to see or hear absolutely nothing of it. Latest reports and photographs indicate that flight tests are continuing and that results have been satisfactory. A big factor in the success of the G.91 has been the Bristol Orpheus engine which became available when the Continental light fighters were being planned and perfectly suited their requirements. Fiat have in fact negotiated a comprehensive licence for production of this fine engine.

It is noteworthy that the general layout of the G.91 follows closely on the lines of the F-86K and the volume distribution of equipment and tankage is probably very similar though the wing appears to be too thin to accommodate any notable quantity of fuel. Gun armament is accommodated in chambers in the fuselage flank and radar equipment will find an effective location in the nose cone. But, in the interests of rapid production, the structure of the G.91 probably uses traditional light-metal techniques rather than the heavy North American tapered thicknesses and extensive machining. The ejection seat is a Martin-Baker Mk 4, similar to those which have already been installed in one or both cockpits of several of the G.82s.

That the little G.91 is a first-class ground-attack fighter is indicated by the fact that it won the NATO competition for this type of machine. Its general resemblance to the F-86K gives some indication of the advantages which Fiats have gained from the licence production of the American machine. This one contract has allowed them to make up the leeway in the post-war research doldrums more quickly than any other Italian company. Acquisition of the licence for the F-86K was in fact a move which typifies the quiet efficiency and business sense of the Fiat concern.

Some time ago Fiat concluded an agreement with the Nardi company for the construction of four prototypes of the Nardi FN.333 single-engined, four-seat amphibian. The first of these made its first flight on October 14, piloted by Ing. G. Ferrari. Taking advantage of Fiat facilities, these machines will be tested and developed as quickly as possible to conform with American C.A.A. specifications. Interest both in Italy and abroad so far suggests that series production of this aircraft may well prove to be justified.

Fiat is, and will probably remain, the key factor in a steadily reviving Italian aircraft industry.



Fiat Type 4002 turbojet for light aircraft.

A WREN RE-HATCHED

TOO seldom is news received of the preservation or rehabilitation of historic aircraft. It is therefore good to learn that one of the diminutive Wren monoplanes originally built by English Electric in 1922 has been rebuilt by the company's aircraft division at Warton aerodrome. It has been flown several times by Mr. P. Hillwood, the English Electric experimental test pilot who has been in charge of the project, and by W/C. R. P. Beamont, flight operations manager and chief test pilot. It is hoped to demonstrate the little monoplane at air displays this year.

This particular Wren was for some years in the Science Museum at South Kensington. The work of reconditioning has been helped considerably by advice from Mr. W. O. Manning, its designer. The aircraft was stripped down and all unserviceable parts replaced, but much of the original airframe remains.

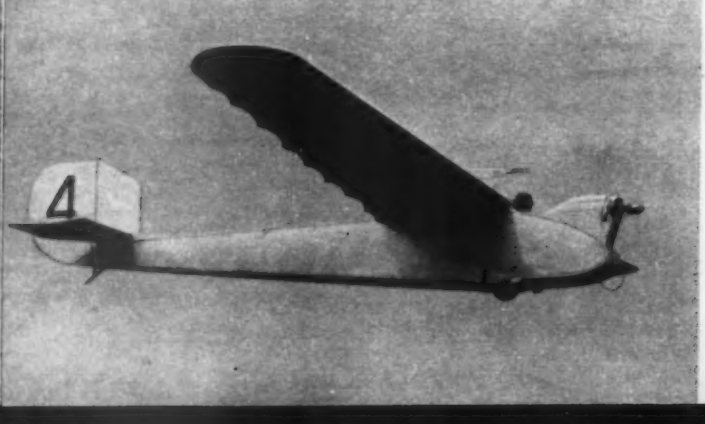
The Wren was designed for the Air Ministry but did not go into large-scale production. It was evaluated by the Aeroplane Experimental Establishment at Martlesham Heath in September 1923. At the Light Aeroplane Trials at Lympne the same year one tied for first place in the consumption trials by recording 87.5 m.p.g., and on another occasion a Wren flew more than 100 miles on a gallon. The engine was a 398 c.c. A.B.C. flat twin, and one of these original units is on the reconditioned aircraft.

ANTARCTIC AIR ACTIVITY

THERE has been much activity in the Falkland Islands Dependencies area of Antarctica recently by both fixed-wing aircraft and helicopters. Dr. Vivian Fuchs, leader of the British International Geophysical Year Expedition, discovered a hitherto unknown range of mountains, 230 miles north-east of Halley Bay on the Caird coast of the Weddell Sea, when flying in the expedition's Otter, of which the pilot is S/L. John Lewis. Dr. Fuchs estimated the summit of the range, which extends for 50 miles, to be between 9,000 and 9,200ft.

Farther north, in Graham Land, aerial photography of the mainland and islands lying off it is being carried out by Hunting Aerosurveys, Ltd., under contract to the Falkland Islands Dependencies Survey. Two Canso amphibians are being employed, and a Bell 47G. All the aircraft have to operate under difficult conditions, the Cansos coming in to land through Neptune's Bellows, the narrow entrance to the great natural harbour of Deception Island (where the survey base has been established), often under a low cloud-base; and one Bell 47G was unfortunately lost on Tower Island owing to an unexpectedly severe change in weather conditions. However, no one was injured and the expedition's ship *Olaf Sven* has now brought a replacement helicopter from Montevideo.

The reconditioned Wren in flight and (right) Mr. Peter Hillwood in the cockpit; with him is Mr. G. Gardener. (See col. 1, above.)



OPERATIONAL ANGLES on the B-47

By COL. RICHARD E. EVANS, U.S.A.F.,
H.Q., STRATEGIC AIR COMMAND

THIS notable study of the principal operational aspects of a high-performance bomber was first published (under the title "Operational Aspects of the SAC Transition to Jets") as a paper presented to the Institute of the Aeronautical Sciences, and later appeared in the Institute's journal, "Aeronautical Engineering Review," by whose permission we reproduce it here, in slightly abbreviated form. Readers who are not technically inclined should not allow themselves to be deterred by the graphs: Col. Evans's paper is an unusually skilful blend of the instructive and the entertaining. His remarks will recall a previous "Flight" article on handling the B-47, by the Editor, in our issue of August 20, 1954.

IN 1955 the last Strategic Air Command B-50 Medium Bomber Wing converted to B-47 jet bombers. Last year saw the deactivation of the first B-36 Heavy Bomber Wing and the activation of the first two B-52 Wings. This year, the KC-135 jet tanker will start to replace the KC-97. The Strategic Air Command has matured from prop-driven adolescence to jet maturity. There have been growing pains, but the rewards and pleasures associated with maturity are usually worth the effort, and such has been our experience.

In November 1951, Major Gen. Frank Armstrong and the men of the 306th Bomb Wing, stationed at MacDill A.F.B. near Tampa, Fla., were out on the ramp in force, awaiting the arrival of the world's first combat jet bomber. The Wing Commander, Col. Michael McCoy, was delivering No. 1. It was a historic occasion. Probably Napoleon, returning to Paris, felt no greater elation than did Mike. It would have been a great day—except for Growing Pain No. 1.

We had spent millions of dollars and millions of manhours preparing for this moment. A new 10,000ft runway had been laid; special new ground power units to start the jet engines had been designed, built and delivered; new U.H.F. radio equipment had been installed in the tower; and a multi-million-barrel JP-3 tank farm had been built and jet fuel had been moved across the Gulf of Mexico. Jet-engine mechanics had received special training at Scott A.F.B., Ill., and at the Boeing factory at Wichita, Kan.; veteran B-29 navigators had received high-speed navigation training at Mather A.F.B., Calif.; and battle-seasoned, 32-year-old pilots had each received $85,000 worth of radar, navigation and bombing cross-training and a preliminary jet check-out in the T-33. The great effort was justified because one of the new jet bombers would carry to an enemy of the United States in a matter of hours as many megatons of destructive power as all of the American and British bombers in World War II carried to Germany, Italy and Japan in a four-year campaign.

We had waited long for this great moment, secure in the belief that everything possible had been done to ensure the success of the 306th Bomb Wing's first jet mission. As Mike approached the runway, six jet engines left characteristic black trails to mark his path. The bicycle landing gear touched down smoothly, and many saw the drag chute for the first time as it deployed and quickly caught the air. And then it happened! An alert fire chief had seen the "smoke" trailing the bomber, and where there's smoke, there's fire, of course. He raced out in front of a startled Wing Commander and signalled him to stop. In a flash, a fire truck was on each wing spewing Foamite into six brand new J-47 engines. . . .

The first lesson we learned was to get off the ground—in a hurry. Engines Nos. 1 and 6 were held at 52 per cent during ground operation to drive the alternators. Numbers 2, 3, 4 and 5 were varied from 40 per cent, the idle position, to 80 per cent during taxi. The average consumption rate on the ground was 150-200 lb of fuel per minute. The B-47, at its average weight and flying at its best cruise altitude (Fig. 1), uses fuel at about this same rate. This means, then, that 1 min on the ground is the rough equivalent of 1 min of cruise; 1 min of cruise is 7 miles. Fifteen minutes' delay at the end of the runway means 100 miles less range.

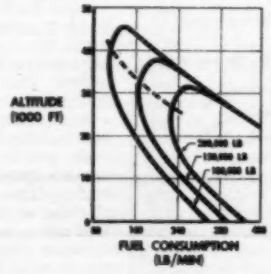


Fig. 1. Fuel consumption (level flight).

Conventional equipment had not placed such high premium on ground operation. We found it necessary to secure air traffic control clearance, including climb-out instructions, before starting the engines. The introduction of surveillance radar during this period greatly facilitated the clearance problem at bases where it was installed.

Empty, the B-47 weighs about 85,000 lb. It can more than double this weight with fuel and payload, going as high as 220,000 lb. The wing tanks each carry about 11,000 lb of fuel. The balance of the load is distributed, longitudinally, in the fuselage. Great care must be exercised in limiting and distributing the load for take-off and to keep the c.g. within limits while dropping bombs and while using and replenishing fuel.

The six J47 engines furnish 36,000 lb of thrust at sea level. Water-alcohol can be used to augment this thrust by 17 per cent, the equivalent of a seventh engine. Thirty-three solid fuel rockets provide the thrust of five or more engines, bringing the total available thrust for take-off up to 75,000 lb. With this power we lifted a 160,000-lb B-47 off the runway at MacDill on a hot day in 3,300ft. With water only, an airplane of the same weight required 6,000ft. Another, without water or A.T.O., used 8,500ft. A.T.O. was rarely employed—it was and is considered an expensive emergency measure. Water was avoided for routine operation in that frequent use resulted in some additional sheet-metal work along the trailing edge and in the flap area.

Runway temperature and field elevation as factors affecting the take-off roll assumed greater significance when we converted to jets. Even with 10,000ft runways, it was necessary—in Florida and Arizona, for example—to restrict the fuel load in order to get off with safety. A 170,000-lb airplane, taking off 2,000ft above sea level, at 40 deg F, needs 7,600ft; increasing the temperature to 80 deg F increases the take-off run to 10,000ft; and an increase in elevation of 1,000ft increases the take-off distance by another 1,000ft. If the engine exhaust gas temperatures are low, if there is a tail wind, an uphill grade, large amounts of water on the runway, an engine failure, or a miscalculation, the airplane will not get off.

To provide a margin for error and a reasonable safety factor, the maximum take-off weight is determined by the "critical field

Fig. 2. Determination of critical field length is accomplished with the aid of these curves, which relate gross weight, airfield height and temperature.

OPERATIONAL ANGLES ON THE B-47 . . .

length." Critical field length (Fig. 2) is the distance required to accelerate the airplane to a particular speed and then either take off on five engines or stop on the runway. This particular speed is termed the "refusal speed." It is calculated for every B-47 take-off and is called out by the co-pilot as it occurs during the take-off run.

The 170,000-lb B-47, taking off at 2,000ft above sea level, at 40 deg F, has a critical field length of 9,000ft. If the available runway is only 7,000ft, the airplane is loaded to 154,000 lb. The critical field length makes no allowance for chute failure, brake failure, blown tires, unusual runway surface conditions, or pilot indecision at the critical refusal speed. Some method of accurately measuring the acceleration rate early in the run is required to assure a safe abort, as well as a safe take-off. With this in mind, we marked our runways at 2,500ft and calculated the speed required at this point. This "line speed" check gave an early indication of the actual rate of acceleration.

Recalling the 170,000-lb B-47 requiring a 7,600ft runway, we find that it should be doing 95 knots at the 2,500ft mark. At this point, the aircraft is accelerating at the rate of 6 kt per 1,000ft. The refusal speed in this case is 116 kt. At refusal speed, the acceleration rate is 12 kt per 1,000ft, placing a greater premium on time for decision. At "refusal," the aircraft is travelling about 200ft/sec. Allowing 3 sec for pilot reaction and 3 sec for reducing power, deploying the drag chute, and applying the brakes, it can be seen that the airplane is about 5,000ft down the runway, doing about 130 kt, when it starts to decelerate.

Three conclusions can be drawn: (1) there is a requirement in modern jet aircraft for an "accelerometer" which will total all the variables, including the negative effect of a faulty water injection system or dragging brakes, and give the pilot an early "go-no-go" presentation. (The N.A.C.A. has developed such a device and is currently testing it on a S.A.C. B-47); (2) ample concrete is the easy solution; (3) some form of arresting gear at the end of the runway is desirable—one "save" would pay the entire installation cost of such a device, would buy a lot of concrete.

The cost in climbing a jet engine to altitude immediately is more than repaid by the greatly improved consumption rates at the higher altitudes. One thousand pounds of fuel will move a B-47 on the deck 18 miles at 425 kt. The same fuel will move a B-47, operating at its best cruise altitude, 58 miles, or three times as far, at the same speed. Power from reciprocating engines is reduced as much as one-third after take-off. Jet engines, on the other hand, are maintained at 96-100 per cent of power during the entire climb.

The lightweight B-47 starts its climb at 4,000ft/min and averages 2,500ft/min to its cruise altitude. The heavyweight airplane starts out at 2,000ft/min and averages 1,300ft/min. With pressurized cockpits, there is little sensation associated with the jet climb-out. The improved rate of climb is dramatic and is fully appreciated only when the airplane bursts through an overcast into the sunlight.

Maximum range is obtained in a jet by climbing immediately at full power to an altitude calculated to be optimum for the weight of the airplane (Fig. 3), then flying a constant Mach. As the weight is decreased by fuel consumption and release of the combat load, the airplane is permitted to climb and seek a higher altitude. And after fuel is taken aboard in flight, the process is repeated, starting at a lower altitude corresponding to the heavier gross weight.

To set the airplane up for maximum range cruise, the outside air temperature gauge and the Machmeter are considered primary—with the indicated-airspeed or true-airspeed indicators, the fuel gauges and the altimeter as secondary. Upon reaching the calculated optimum altitude, the power setting for the observed O.A.T. is set. The airplane is then permitted to climb or descend to establish the desired Mach. As the O.A.T. changes, power is adjusted and the process continued. With the autopilot altitude control engaged, the airplane will, of course, hold a constant altitude and pick up speed. As the Mach builds up from, say 0.74 to 0.76, the altitude control can be momentarily disengaged to permit the airplane to seek a new level. This "step climb" procedure is a practical answer to the jet cruise climb control problem and has no significant negative effect on range.

A planned step climb, with longer steps, which brackets the optimum climbing flight-path, is the answer to the altitude clearance problem. The range loss is not great, can be calculated, and is considered a necessary operational expense.

Except for wind, weather phenomena at jet operating altitudes are not significant. Flight except during refuelling is normally above the median-altitude cloud decks; only infrequently is it in high cirrus layers which are thin and dispersed. The moisture content of the upper air is so slight that significant surface ice is never seen. Clear-air turbulance is encountered in the upper air along the shear lines of the jet streams. At cruising speeds, the disturbance causes the aircraft to rock and roll, but there are no sharp bumps such as are encountered at high speeds near the surface or at moderate speeds in thunderstorms.

At 35,000-40,000ft, a thunderstorm will occasionally be encountered which appears to reach up to another 10,000-20,000ft. These "whoppers" are not seen every day, but a few form every season in Arizona, New Mexico, Texas and along the Gulf Coast. The thin wing of the B-47 can flex 17ft at its tip—and *does* in a thunderstorm. This makes for a smoother ride in turbulent conditions, with the wings absorbing most of the shock. However, it can be said that few B-47 pilots, after observing their flapping wings in a thunderstorm, share Leonardo da Vinci's thesis that airplanes should fly like birds.

Colonel Mike McCoy was riding in the observer's position in the nose one time, with two student pilots occupying the tandem pilot positions, when a "dark area" was discovered to be a thunderstorm. With no flight instruments before him, and being a man with a highly developed inquisitive instinct (in this case he desired to know which way was up), he growled over the intercom: "One of you guys climb outta there—I'm coming up!" Whereupon all *three* pilots met in the passageway. . . .

At jet altitudes, 50-kt winds are the order of the day. Winds of 100 kt are frequently routinely encountered; 150-knot winds are occasionally encountered. (They are usually going the wrong way!) We have learned to plot with acceptable accuracy the general pattern of the wind flow at all operational altitudes. However, it is still difficult to predict for a specific time the exact position of the jet streams in space laterally and vertically. Because of the steep gradient of the isotacs (lines of constant wind speed) about the jet stream, again laterally and vertically, the prog must be precise to be useful. For this reason, when operating near a jet stream, it is essential that a running check be made on ground speed and course. Mapping radar is the immediate answer to this problem and is considered an essential item of navigation equipment for modern, long-range jet aircraft.

Modern bombers are equipped with nose and tail warning radar. An enemy fighter can thus be detected in time to take defensive action. This system requires that the subject be illuminated by the fighter's radar. The navigator in the B-47, however, can convert his mapping radar into air surveillance radar (simply by failing to reduce the size of the altitude hole) and "see" the other aircraft in his formation. The airborne tanker transmits a radar signal which can be seen as a coded indicator on the receiver's scope. Thus the receiver becomes an airborne G.C.I. director.

Fig. 3. Maximum range.

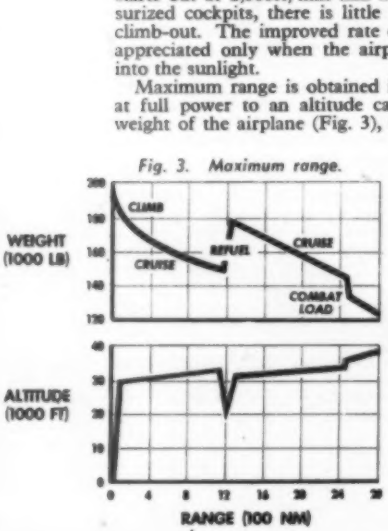
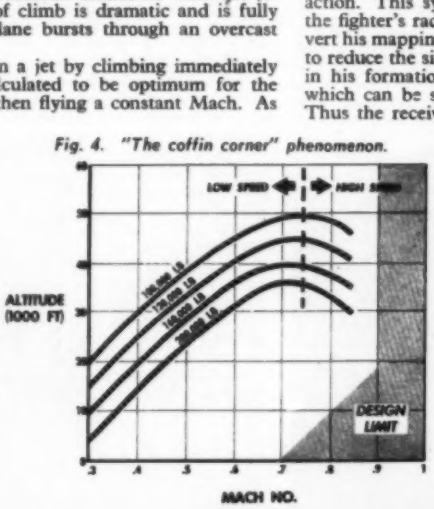


Fig. 4. "The coffin corner" phenomenon.



The B-47 introduced a new expression to bomber pilots—"the coffin corner." It was rumoured that, if you ever got into the coffin corner, you would, in the vernacular of the jet jockey, "buy the farm." In the coffin corner, your airplane would stall not only because you were running out of speed but also because you had too much speed! If you pulled back on the stick, you entered a slow-speed stall. If you pushed forward, you would enter high-speed buffet. The coffin corner, we learned, was the altitude at which the airspeeds for low-speed stall and compressibility stall for a given weight, coincide (Fig. 4). For a 200,000-lb B-47, this occurs at 0.75 Mach at 36,000ft. A 100,000-lb

B-47 is in the same predicament at 0.75 Mach at 50,000ft. For the 200,000-lb airplane, the corner is approximately 9,000ft above the best cruise altitude, leaving more than ample margin for a miscalculation in determining weight or altimeter error.

Turbulence further restricts the size of the operating envelope at the higher altitudes. Jet pilots have gotten into difficulty in trying to get above towering cumulus clouds, when actually they should have descended 5,000ft below their optimum altitude. Flying below but near the corner, they can be stalled by heavy gusts. Recovery is effected without difficulty, but the airplane quickly slips over into high-speed buffet. With indicated air speed fluctuating wildly because of partial blocking of the pitot tube by moisture and the vibrations of the shock-mounted instrument panel, the pilot is not sure whether he has entered high-speed buffet or a secondary stall. He literally does not know whether he is coming or going. But of course the coffin corner, or, more properly, the aerodynamic ceiling, is no more dangerous than an open elevator shaft. When the pilot knows where it is, he can easily avoid it. When he must work near it, he keeps his eyes open.

In the early days, "aileron reversal" was another expression to strike terror in the heart of the neophyte B-47 pilot. It seems that at certain speeds, when the wheel was rolled hard over to one side, the airplane would roll in the opposite direction. This was understandably disturbing. At high speeds, the aileron acted on the flexible wing much as a servo-tab acts on the elevator. The deflected aileron caused the trailing edge of the outboard section of the wing to twist in the opposite direction. Thus the wing became a larger control surface than the aileron, neutralizing its effect at certain speeds and "reversing" it at higher speeds.

The power loading which makes jet flight such a delightful and exhilarating experience can quickly become a force for destruction if the grasp of the reins is relaxed even momentarily. The power required for high-altitude operation is literally too much for low- or even medium-altitude operation.

A pilot flying a 150,000-lb B-47 carrying "climb power" levelled off momentarily at 10,000ft in order to pick his way through broken clouds on a V.F.R. climb-out. His rate of climb had been 2,200ft/min and his indicated air speed 350 kt (420 kt T.A.S.). In level flight, with no power adjustment, his speed was increasing at the rate of 1 kt/sec. Within 60 sec he would be entering the critical speed zone. If he eased into a slight (1,000ft/min) descent he would be accelerating at the rate of 1.5 kt/sec. Sixty seconds, at this rate, would bring him well into the danger zone. He turned the airplane over to the co-pilot at this time and directed his attention to the tuning of his A.D.F. He stated later that he was distracted for "no more than 30 sec." When he looked up, the airplane was in a dive of approximately 20 deg and a bank of 25-30 deg and had an indicated airspeed of 450 kt. He immediately applied full right aileron. The airplane continued to steepen its spiraling dive and in a few seconds struck the ground at a speed of perhaps 600 kt.

The pilot had discovered his predicament in time to recover, but he failed to take the proper corrective action (Fig. 5). Had

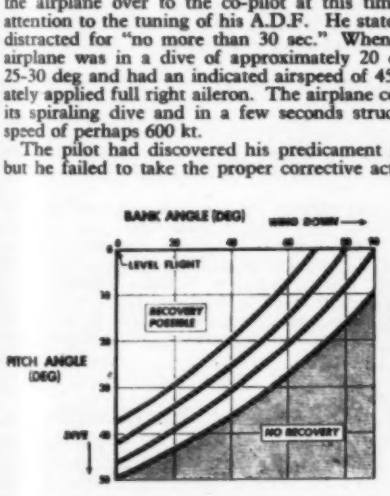


Fig. 5. Another critical point in B-47 handling—onset of loss of control in a fast diving turn.

he cut power and applied 125-150 lb of back pressure on the stick, he would have effected a 3g recovery. With airspeed, pitch and bank angle increasing simultaneously, he reached the point of no return in a matter of seconds. Once beyond this point, it is not possible to apply sufficient back pressure on the stick—even with power off—to keep the aircraft from continuing to accelerate. The pilot ejected and confessed he did not fully understand the effects of excessive speed on the aircraft.

Another pilot stalled off the end of a refuelling boom into the overcast. He lost control of the airplane and crashed. The co-pilot, the sole survivor, said he guessed they got into a steep spiral and that, while they were pulling out, the aircraft struck the ground in a level attitude and bounced back into the air. When the final crash did not follow immediately, he assumed they must be on the ground. Noting that there was a large opening where the fuselage had been, he stepped out. Probably recalling that old story about "watch that first step—it's a dilly," he discovered that he was falling in space, pulled his ripcord, and landed uneventfully. Of course, the aircraft had not hit the ground at all; it had hit the air—at something over 500 kt.

Probably the most important decision to be made in a jet is when to let down. Once the jet leaves the higher altitudes where its engines like to operate, it is committed to land. If it must divert, the decision should be made prior to descent. The pilot flying above the overcast is completely dependent upon the information he receives from the ground in making his decision.

In the early days, airborne U.H.F. sets were extremely temperamental, and ground-based sets were few and far between and, we were sure, were turned down so that our infrequent requests would not interfere with regular V.H.F. business. Today, U.H.F. has a high degree of reliability, a U.H.F. ground station is within range or only minutes away anywhere within the Z.I., and the C.A.A. stations are manned by skilled, solicitous operators. Time is indeed the essence of the jet pilot's problem, and yet usually, the best weather information that can be obtained in flight is an hour old. If he is attempting to formulate his plans 30 min before arrival, he is forced to *guess* what changes would likely take place in an hour and a half.

We have solved this problem at our jet bases by setting up a U.H.F. pilot-to-forecaster frequency and requiring the forecaster to take *continuous* cognizance of the weather. The Strategic Air Command has a global (northern hemisphere) weather station at headquarters and sends advisories *via* land lines and C.A.A. stations to S.A.C. aircraft anywhere in the country. Direct H.F. transmission has proved unreliable for this purpose. H.F.-equipped B-47s have had voice contact with headquarters S.A.C. while flying over Europe—yet have been unable to raise Omaha while flying over Kansas City.

The B-47 is not equipped with dive brakes or spoilers, but the landing gear is an extremely effective air brake. There are two basic jet let-downs (Fig. 6)—one with the gear extended, one clean.

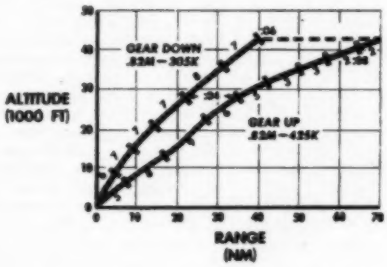


Fig. 6. Two alternative let-down procedures. Descent in the "clean" configuration saves fuel and time.

The gear-down descent is the quickest (6 min *versus* 9 min) and uses less fuel (310 lb *v.* 530 lb). However, the clean descent is more economical in both time and fuel when both procedures are started from the same point in space—i.e., 70 miles out. The 30 miles of cruise to the let-down point in the case of the gear-down descent costs another 4 min and 450 lb of fuel. The clean descent is 1 min quicker and takes 230 lb less fuel.

In the idle position, the fuel regulator maintains the power at about 75 per cent at 45,000ft, 65 per cent at 30,000ft, 55 per cent at 20,000ft, and 40 per cent at 15,000ft to sea level. This is the reason for the flat descent in the clean configuration at the higher altitudes. The gear-down descent is flattened out somewhat by the 305 kt I.A.S. restriction with the gear extended.

There is little sensation associated with the rates of descent experienced in the clean descent down to 20,000ft, but the 9,000ft/min rate between 20,000 and 10,000ft is something of a thrill, particularly with the high air speed. As a reasonable compromise, we settled on an *en route* penetration in the clean configuration to 20,000ft over the let-down fix. (This is the point where the fuel consumption curve starts to steepen.) The gear was then lowered, and the descent continued at 4,000ft/min, usually in a tear-drop pattern oriented to bring us into the field at the minimum altitude. This procedure required 2 min more than the clean-all-the-way descent, 1 min more than the gear-down method. However, it provided for a gear check at an altitude where the fuel consumption was still reasonable, and it was certainly more comfortable.

With tear-drop or 90 deg-270 deg penetration patterns, using G.C.A., we have landed full wings of B-47s (45) under instrument conditions at 4-min intervals. With air surveillance radar and G.C.A. and with straight-in or near straight-in *en route* penetrations and approaches, we have reduced this separation to 1 min.

L.F. A.D.F. fixes at jet altitudes are frequently off as much as 15 miles. The old ARN-6 or "radio compass" is unsatisfactory for jet operation. The omnidirectional V.O.R., on the other hand, is accurate, simple to operate and reliable. The optimum penetration and approach is from an omni-station located about 100 miles out and generally in line with an I.L.S. The Air Force recognizes that, for jets and conventional aircraft alike, the ground-radar-monitored I.L.S. is the best system.

[*Contd. overleaf*

A wing of B-47Es (like that above) represents an investment of £50m for the aircraft alone. Over 40 such wings are currently active.

OPERATIONAL ANGLES ON THE B-47...

There are two basic reasons why the jet landing operation calls for greater precision than does the conventional landing: (1) jet engines accelerate slowly, and (2) jet aircraft decelerate slowly. The J47 requires from 12 to 20 sec to accelerate from 40 (idle) to 100 per cent r.p.m. Most of this time is required to accelerate from idle to 55 per cent, and it is desirable to carry 55 per cent until the landing is assured. At the same time, however, it is conversely desirable to reduce power to a minimum during the approach, in order to steepen, as much as possible, the characteristic, flat glide angle of the jet. Because the airplane is streamlined and has no windmilling propellers, it does not want to stop flying, and, once on the runway, it does not want to stop rolling. Ten knots excessive speed at flare-out will increase the required runway length by 1,700ft. On a wet runway, at 3,000ft elevation and 80 deg F, a 120,000-lb B-47 will stop, using drag chute and brakes, in 5,400ft. With a G.C.A. touchdown point 2,000ft down the runway and 15 kt excess speed on final approach, it will stop just 50ft short of the end of a 10,000ft strip. If the chute had failed under these circumstances, the aircraft would have required 14,200ft on the wet runway, 11,000ft on a dry runway.

Approach speeds for conventional heavy bomber and transport-type aircraft may be 30 per cent higher than the stall speed—i.e., 100-kt stall, 130-kt approach speed. To keep from floating right on by the airfield the jet not equipped with dive brakes, spoilers or approach chutes must reduce this margin over stall by one-half. For example, the 100,000-lb B-47 stalls at 114 kt; the best approach speed is 128 kt, with 14 kt separation.

Working closer to the stall speed is not dangerous provided two important factors are considered: the increase in stall speed due to bank, and the increase due to g forces. If the 100,000-lb airplane, approaching the runway at 128 kt, banked in excess of 35 deg, it would stall. This places a definite restriction on the amount of manœuvring which can be done after breaking a particularly low ceiling, makes a point of killing drift early during G.C.A. and I.L.S. approaches, and emphasizes the need for approach lights out to 3,000ft. If 0.25g force is placed on the 100,000-lb B-47 flying at its approach speed, it will stall. The down-wind leg is flown at best approach speed plus 30 kt. This excess is systematically bled off during the turn into final. The induced stall is, therefore, not a problem unless there is turbulence or gusting winds or possible downdrafts at the runway threshold.

There is nothing unconventional about jet traffic patterns. In fact, one pattern is standard at all S.A.C. stations—for jet and conventional traffic alike. Traffic altitude is 1,500ft above the terrain, and the turn onto base leg is started 45 sec after passing the end of the runway on the downwind leg, with an adjustment for higher-than-normal wind velocities. Most pilots "eyeball" this point, by starting the turn when the sweptback wing tip passes the end of the runway. Power is adjusted to lose 700ft in the 180 deg turn, rolling out on final at 800ft.

The bicycle gear was found to facilitate cross-wind landings while the sweptback wing and the approach and brake chutes complicated the cross-wind landing. It was found that the B-47 could be landed without undue risk if the 90-deg cross-wind component was not in excess of 25 kt. The accepted procedure was to track directly into the runway by holding the wing down on the windward side until the aircraft was actually on the ground. The upwind outrigger gear would touch first. There was no reason, with the bicycle gear, to straighten up before landing, and there was good reason for not yawing excessively. Because of the geometry of the sweptback wing, airflow over the advancing wing during a yawed condition becomes more chordwise, resulting in increased lift for that wing, while flow over the retreating wing becomes more spanwise, thus resulting in a loss of lift and, at extremely low speeds, possibly a stall for that wing. The permissible 90-deg cross-wind component is reduced to 20 kt when the approach chute is deployed. Both the approach and the brake chutes tend to hold the rear gear off the ground and "weathercock" the airplane.

If the front gear strikes the ground ahead of the rear gear and if there is excessive speed, the airplane will bound back into the air in a nose-high attitude. If the power has been reduced to the idle position, it is not possible to catch the airplane by sudden use of the throttles. In fact, this procedure will only aggravate the condition. The power will not take effect until the aircraft has flown through a second bounce. If it should happen to be at the peak of the second bounce and if the power comes up unevenly, there may be insufficient aileron to prevent the outboard engine pod on the low-power side from striking the ground.

We flew over a million hours in the B-29 during 1950, 1951 and 1952. We had 189 accidents, resulting in a rate of 17 accidents per 100,000 flying hours. Of these, 68 (36 per cent) were landing accidents.

We flew the B-47 a little less than one-half million hours during 1952, 1953 and 1954. We had 75 accidents, resulting in the same rate as the B-29's—17 accidents per 100,000 hours. Thirty-five (48 per cent) of the B-47 accidents occurred during the landing phase. We have indeed matured, and we have learned many lessons. We have applied these lessons, and the state of the art has advanced.

The larger B-52, weighing over 400,000 lb, flies higher, faster and farther than the B-47. With wing spoilers, it lands *more slowly* than the B-47 with better control. The J57 engine accelerates in half the time required by the J47. When thrust reversal is added to the next line of jet aircraft, we will drop the brake chute, and jet flying will have become a relatively simple and safe operation.

But commercial and military jet operators will both have one unsolved problem for a long time to come. Jets are noisy, and Americans prefer their decibels in modest quantity and their cycles-per-second in the ranges of the audio spectrum below 15,000. Low approaches for landing with the throttles retarded are no problem, but heavyweight take-offs with 100 per cent of power from six and eight jet engines are another matter. If the airlines can solve the noise problem, their transition to jets will be a breeze.

A NEW RESEARCH FELLOWSHIP

AMONG prominent industrialists concerned at the increasing shortage of young scientists and technicians in this country is Sir Alan Cobham, chairman and managing director of Flight Refuelling, Ltd. His particular interests include the Wessex Technical Education Association, a body being formed to create funds for the furtherance of such education in the West of England.

It is now announced that to advance these aims Sir Alan has sponsored a Fellowship at Southampton University. To be known as the Sir Alan Cobham Research Fellowship, it will be of approximately three years' duration and will be open to candidates with industrial or research experience who are members of the British Commonwealth and are preferably British, Canadian or Australian. It is envisaged that the Fellow will be between 25 and 30 years of age. Value of the Fellowship is £800-£900 a year.

The first appointment is likely to be made shortly, selection being by a committee of representatives from Flight Refuelling, Ltd., and Southampton University.

The University has a considerable reputation for aeronautical studies, current work including investigations of aircraft noise and its effect on fatigue, of helicopter vibration, and of structural damping. The Professor of Aeronautical Engineering is Prof. E. J. Richards.

THE INDUSTRY

Among those affected by the Vickers reorganization reported below are (left to right) Mr. Basil Stephenson, Mr. H. H. Gardner, Brig. J. Clemow, Mr. G. F. H. Hemsley, Mr. David James, Mr. A. N. Clifton, Mr. E. W. J. Gray.

Vickers-Armstrongs Reorganization

THE reorganizational changes at Vickers-Armstrongs (Aircraft), Ltd. (referred to in a "From all Quarters" item in this issue), will not become fully effective until April 1, the date on which Brigadier Clemow, named as chief engineer (guided weapons), is due to join the company from the Ministry of Supply, where he has been Director of Guided Weapon Projects since June 1955. From 1951-53 he was Assistant Director of Guided Weapon Development, then from 1953-55 was loaned to the Fairey Aviation Co., Ltd., where, as Head of Guided Weapon Development, he led the team which produced the Fireflash.

Until Brig. Clemow joins Vickers Mr. H. H. Gardner, the new chief engineer (military aircraft) will also act as chief engineer (guided weapons). Mr. Gardner has been a special director of Vickers-Armstrongs (Aircraft), Ltd., since 1954. He joined Vickers Aviation, Ltd., in 1929, became chief technician at Weybridge in 1941, assistant chief designer (aircraft) in 1945 and chief designer (guided weapons) in 1953.

Mr. Basil Stephenson, F.R.Ae.S., the new chief engineer (civil aircraft), was appointed a special director of Vickers-Armstrongs (Aircraft), Ltd., in 1954. The previous year he had succeeded Mr. G. R. Edwards as chief designer (aircraft), and in this capacity has been in charge of the design organization responsible for the Vanguard. He had previously, as assistant chief designer, played an important part in the design of the Viking, Viscount and Valiant.

Other appointments at Vickers-Armstrongs (Aircraft), Ltd., resulting from the reorganization are: Mr. G. F. H. Hemsley, A.F.R.Ae.S., formerly deputy chief designer (aircraft) at Weybridge becomes assistant chief engineer (aircraft); Mr. David James, B.Sc., F.R.Ae.S., formerly chief structural engineer, becomes chief designer aircraft (Weybridge); Mr. A. N. Clifton, M.B.E., B.Sc., F.R.Ae.S., formerly assistant chief designer (Supermarine) becomes chief designer aircraft (Supermarine); and Mr. E. W. J. Gray, B.Sc., M.I.Mech.E., F.R.Ae.S., becomes chief designer aircraft (Hurn).

Mr. Hemsley was chief aerodynamicist (1951-53) and assistant chief designer (1955-57) before becoming deputy chief designer. Mr. James was chief stressman before he became chief structural engineer. Mr. A. N. Clifton became chief of Supermarine's Technical Office in 1930 and assistant chief designer in 1948. Mr. Gray was formerly chief designer, Handley Page (Reading), Ltd., and in this appointment was in charge of the design of the Herald.

English Electric Presentation

ON January 4 the first awards to engineering apprentices training with the English Electric Co., Ltd., at Warton Aerodrome, Lancs, were presented by Lord Caldecote, a director of the company. The J. R. Harwood Shield was handed to Neil Wolstenholme (21), judged the best all-round apprentice who began training in 1953, and to Harry Malley (20), judged the best who began in 1954.

In his speech [to which reference was made in *Flight* for last week] Lord Caldecote said that the company was continuing to receive inquiries for modifications to the Canberra and that there were clear indications, "even at this early stage," that there would be many developments to the P.1 which would "keep the company busy for a long time."

S/L. Duke's New Post

SPECULATION about the future of S/L. Neville Duke, D.S.O., O.B.E., D.F.C., A.F.C., since his resignation as chief test pilot of Hawker Aircraft, Ltd., came to an end on January 15 when it was announced that he had joined the Board of the group of engineering companies owned by Mr. Brian D. Songhurst. These are: Serco, Ltd., Serco (Ulster), Ltd.; A. Boucher (Metals), Ltd.; and Engineers Supply (London), Ltd. Their head office is at 387 City Road, London, E.C.1, and they are engaged in supplying the aircraft and many other industries with a wide range of tools, equipment and materials.

New Dowty Director

THE appointment of Mr. N. H. Payne to the Board of Dowty Fuel Systems, Ltd., has been announced. He became chief engineer to the company in May last year, having previously held a similar appointment with Normalair, Ltd., since 1952. Mr. Payne served his apprenticeship with Armstrong Siddeley Motors, Ltd., and returned to that company after taking an honours degree at Birmingham University in 1933. At the outbreak of war he joined Rotol, Ltd., and from 1944 until going to Normalair he was with the de Havilland Engine Co., Ltd.

Mr. N. H. Payne.

It is also announced from Cheltenham that Sir Godfrey Ince, G.C.B., K.B.E., was appointed to the Board of the Dowty Group, Ltd., on January 14. He has had a distinguished Civil Service and political career; and from 1944 until January last year he was Permanent Secretary to the Ministry of Labour and National Service.

Saunders-Roe Appointment

IT has been announced that Mr. T. L. Ciastula, Dipl.Ing., A.M.I.Mech.E., A.F.R.Ae.S., has been appointed Chief Designer of the Helicopter Division of Saunders-Roe, Ltd., having formerly been Chief Technician (Helicopter Division). Mr. Ciastula, who was born in Poland and graduated in mechanical and aeronautical engineering at the technical university in Warsaw—his Dipl.Ing. degree is equivalent to M.Sc.(Eng.)—came to England from France in 1940 as an officer of the Polish Air Force. After operational service as a fighter pilot he was posted in 1943 to the R.A.E., Farnborough. He joined Saunders-Roe, Ltd., in 1948 as a senior aerodynamicist; in November 1952 he transferred to the company's helicopter division as chief project engineer and three months later was appointed its chief technician.

Mr. T. L. Ciastula.

Kenting Aviation Posts

RECENT news from the Canadian aircraft industry is that Mr. A. F. Soutar, manager of Kenting Aviation, Ltd., of Oshawa and Toronto, has been appointed to the Board of Directors of the company. The first pilot to be employed by the Photographic Survey Company, Ltd., after its formation in 1946, Mr. Soutar has since been engaged on a large number of varied flying operations for the Canadian Hunting companies and has logged over 3,000 hr on helicopters alone.

Another Kenting Aviation appointment recently announced is that of Mr. J. N. H. Greenshields as chief check pilot. Mr. Greenshields, who joined Kenting in 1950, was previously with B.E.A. and with Pest Control, Ltd.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

The Spitfire 19 referred to by Mr. A. G. Sharp.

The Auxiliaries

ON the news this evening [January 16] it is stated that the question of the flying squadrons of the R.Aux.A.F. and the R.N.V.R. has apparently been settled, the reasons being given as in the interests of national economy.

Surely this decision refutes the whole principle of these squadrons. The squadrons provide the nation with a pool of experienced pilots to draw upon in an emergency and the aircrew for these can be obtained from the ex-Regulars who do not want to take up permanent commissions.

If the national economy warrants the disbandment of these squadrons surely the shocking waste of public money on National Service aircrew and the University Air Squadrons should be stopped first and foremost.

Saffron Walden, Essex. COLIN HILL.

"Open Skies"

THE publicity given to the American "Open Skies" Exhibition could overshadow British achievements in this field, and the presentation, though interesting and impressive, is leading to misconceptions by the general public. I shall be grateful, therefore, if you will allow me space to comment.

(1) The exhibition discloses nothing in technique or equipment not already known and available to British experts.

(2) The origin of the proposal to use air photography in peace as a disarmament check as opposed to offensive and defensive intelligence in war was a letter to the Press from the writer on October 11, 1944. This letter emphasized the tremendous contribution of the Royal Air Force using British cameras and lenses in winning the war, and proposed the continuance of photographic reconnaissance in the conquered countries. The Eisenhower scheme, as it has become known, is a development of a suggestion originating in this country twelve years ago.

(3) Given good weather enormous areas can be photographed with a few aircraft, since a single wide-angle camera flying at 60,000ft records 280 square miles on one photograph; but for interpretation of the type which disclosed the flying bomb at Peenemunde, selected areas must be photographed with narrow-angle cameras covering 4½ square miles per photograph. Weather and logistics mean that a few hundred vital large-scale photographs take months to accomplish. This must be borne in mind when the publicity about selected cases suggests the job can be done in days and hours.

When my letter of 1944 was written we knew little about the enemy effort in air photography. On the events uncovered after the war our Air Force and their equipment had a massive superiority, and there is today a continuing effort in research and development which must be maintained if we are to keep our lead in this vital field.

London, N.W.10. J. E. ODLE.

[Mr. J. E. Odle, F.R.G.S., is an authority on aerial photography and air survey. He is joint managing director of the Williamson Manufacturing Co., Ltd.—Ed.]

Sequel to a Story

AS an ardent enthusiast and reader of your excellent journal, I have been most interested in Dr. A. A. Griffith's recent summary of his father's life, and in the disclosure of his resting-place.

As soon as I had read "A Story—and Its Sequel" (*Flight*, January 11), I set off for the Port Erin churchyard, quite close to my home here—determined to locate this fabulous man's grave.

Surely enough, I eventually found myself standing in deep reflection before the following epitaph:—

George Chetwynd Griffith
Author Traveller Journalist
Born Plymouth 20th Aug 1857
Died Port Erin 4th June 1906

This has been most interesting to me, firstly having read "Outlaws of the Air" and secondly living so close to the resting-place of a truly remarkable man and not having known it.

Thanking you for endless hours of absorbing reading.

Port Erin, I.o.M. DONALD G. DOBSON.

Met. Spitfires—a Farewell

I ENCLOSE a photograph [reproduced above—Ed.] which I think may prove of interest to your readers. I took it at Speke Airport, Liverpool, and it shows one of the last three Supermarine Spitfires in service with the R.A.F. They are based at Woodvale, Lancs, with Short Bros. and Harlands' met. flight, and every day one takes off to fly down to Worcester to gather data for the B.B.C.'s 1 p.m. weather forecast.

The machines are finished in P.R. blue overall, with black or yellow spinners. They are to be withdrawn from service and scrapped this month and replaced with de Havilland Mosquitoes.

Liverpool. A. G. SHARP.

Transatlantic Flight Souvenirs

WE have recently obtained a number of souvenirs of the first transatlantic flight, which was made on July 14/15, 1919, by Alcock and Brown. These items include Whitten Brown's flying clothing, his black-cat mascot "Twinkletoes," the Atlantic chart believed to have been used on the flight, the Vimy's compass and various documents.

We propose to build up a small permanent exhibition of relics of this great flight, and if any of your readers have knowledge of the whereabouts of other souvenirs of the occasion I would be very glad to hear from them. We are already fairly well provided with photographs and contemporary newspaper cuttings.

Weybridge, Surrey. CHARLES GARDNER,
Information, Publicity and Promotions Manager,
Vickers-Armstrongs (Aircraft), Ltd.

Russian Airline Equipment

I WAS interested to see Mr. Muirhead Johnston's article about Russian and Chinese air services. However, when he states that aircraft such as the Yak-18 may still be used on local routes, he must surely be referring to the Yak-16, not the 18. The Yak-18 is in fact a two-seat trainer and could not possibly be used as an airliner, whereas the Yak-16 has for some time been in service with Aeroflot and is a twin-engined ten-passenger feeder-liner.

Arbroath, Angus. R. A. G. STUART.

[Yes—the Yak 16 was intended—Ed.]

FORTHCOMING EVENTS

Jan.	29.	R.Ae.S.: Section Lecture: "Design for Production," by E. D. Keen.
Feb.	2.	British Interplanetary Society: "Accelerations in Flight," by W/C. F. Latham.
Feb.	5.	Aviation Forum: "Catering on Aircraft," by W. Michel.
Feb.	7.	R.Ae.S.: Main Lecture, at Halton, "Synthetic Training Methods in Aviation," by W. Makinson.
Feb.	11.	Institute of Transport: Brancker Memorial Lecture: "Competitive Economics of Pure-jet v. Turboprop Aircraft," by Marshal of the Royal Air Force Lord Douglas of Kirtleside, G.C.B., M.C., D.F.C., M.Inst.T.
Feb.	12.	Joint R.Ae.S. and Helicopter Association Lecture: "Vibration Problems Associated with the Helicopter," by O. L. L. Fitzwilliams, A.F.R.Ae.S.
Feb.	14.	R.Ae.S.: Main Lecture: "The Fairey Delta," by R. L. Lickley and P. Twiss.
Feb.	15.	Institute of Navigation: "Navigation and Traffic Control Over the North Atlantic," by D. O. Fraser.
Feb.	16.	British Interplanetary Society: Chemical Demonstration by Dr. J. Diederichsen.
Feb.	26.	R.Ae.S.: Section Lecture: "Recent Advances in the Design of Aircraft Tyres and Brakes," by H. W. Trevaskis, A.F.R.Ae.S.
Mar.	7.	R.Ae.S.: Tenth Louis Bleriot Lecture: "New Methods in Aircraft Production," by M. Badré, production director of Sud-Ouest Aviation.
May 24–June 2.		Paris Aero Show, Le Bourget.
Sept.	2-8.	S.B.A.C. Show, Farnborough.

R.Ae.S. Branch Fixtures (to February 15):

Jan. 30, Preston, "Diving and Underwater Engineering," by I. Fraser; *Southampton,* "Atomic Energy for Aircraft Propulsion," by J. E. Perkins; *Weybridge,* "Electronics and the Aircraft Industry," by Dr. C. F. Bareford. *Feb. 5, Boscombe Down,* "Human Limitations of High Performance Flight," by G/C. W. K. Stewart. *Feb. 6, Luton,* "Production of Light Alloy Forgings," by J. Crowther. *Feb. 13, Leicester,* "Flight Development of Modern Prototype Aircraft," by C. F. Bethwaite. *Feb. 15, Brough,* Annual Dinner and Dance.

Gathered under one roof—the lofty roof of the Britannia hangar at Bristol—are three of the four main variants of the Britannia family. In the doorway is G-ALBO, the prototype 100; in the left background is G-ANCA, the prototype 300; and in the foreground is G-AOVA, first of the long-range 310s.

CIVIL AVIATION

S.A.A. AND THE COMET

A STRONG de Havilland team left London Airport on January 18 to spend two weeks in Johannesburg discussing the Comet 4 with South African Airways. The party consisted of Mr. R. E. Bishop, design director; Mr. Frank Lloyd, commercial sales manager; Mr. John Cunningham, chief test pilot; and Mr. George Wilkes, aerodynamics.

It will be recalled that South African Airways, who operate in partnership with B.O.A.C. between London and South Africa, flew Comet 1s chartered from B.O.A.C. on this route in 1953 and 1954.

TWIN PIONEER IN SERVICE

A FORTNIGHT ago we recorded the departure for Switzerland of the Scottish Aviation Twin Pioneer G-AOEO. It was not at the time disclosed that soon after arrival the aircraft would be used by Swissair to operate a regular service—thus introducing the Twin Pioneer on passenger-carrying operations for the first time. But earlier this week there came the best piece of Twin Pioneer news yet—a firm order for three from K.L.M. for the airline's Dutch New Guinea associate De Kroonduif. Delivery will be in April. Twin Pioneers will, K.L.M. state, replace the Beavers at present in service.

G-AOEO, which arrived in Zurich some days ago for crew familiarization, has been chartered by Swissair while the airline makes up its mind whether it wants to buy—an unusual but welcome "on approval" procedure. It will be operated in the Swissair colours which it has worn since the S.B.A.C. Display last year, but with its British registration, on a regular service from Zurich to Davos, St. Moritz, La Chaux-de-Fonds, and Geneva.

Two services will be flown. The first, called "Swissair Pioneer Ski-lift," will operate three times a week until the middle of March from Zurich to Davos and St. Moritz. The timetable will be arranged to connect the service with Swissair's international flights into Zurich. The second service, the "Pioneer Jura Airlift" was scheduled to start last Tuesday and will be operated by the same aircraft as the "Ski-lift" service. Until March 29, when the period of the charter expires, the Twin Pioneer will operate a service three times a week between Zurich, La Chaux-de-Fonds, and Geneva.

PLANS FOR THE CARAVELLE

THE second prototype Caravelle, which is to make a six-week tour of the U.S.A. in April, is now being test-flown by Sud-Est, Marignane, to perfect the pressurization and air conditioning systems, the cabin sound-insulation, and the radio equipment. When this work is finished in a few weeks' time the aircraft will return to the hangar to be brought up to standard—both in equipment and cabin furnishings—for its important sales tour.

When the Caravelle returns to France at the end of May it will be handed over to Air France. It will then continue the 620 hours of Caravelle operational flying completed by the first prototype last November. That machine is now being given a structural overhaul, but it will be ready by about March 15 to start its final de-icing tests. These will be followed, at the other climatic extreme, by tropical tests. It will appear at the Paris Salon in June, after which it will again return to the hangar for the embodiment of improvements to the flying controls feel system. When this work is finished, by about October 15, the aircraft will rejoin Air France.

American Airlines are installing at their four major training bases DC-6 and DC-7 cockpit-procedure trainers of the kind shown here. The instructor (left) can test the reactions of the crew by introducing any emergency likely to be encountered in operation.

C.P.A.L. have introduced this galley service truck, of 565 cu ft capacity, to speed up the loading of 10,000 meals a month at Vancouver Airport.

CIVIL AVIATION . . .

A PLAN FOR THE ATLANTIC

THE "jet-age task force" appointed by I.C.A.O. at Caracas last June to study the world's air traffic control problem has completed its first report.* The object of its attention was what it describes as the "world's outstanding case" for improvement—the North Atlantic. In a workmanlike study the task force describes the shortcomings of the A.T.C. and communications facilities in this region, and makes some recommendations for improvement.

There were, it appears, something like 84 flights a day last summer on the heavily flown route between North America and northwest Europe. This figure excludes a "substantial additional volume" of military flights. If the annual 15 per cent rate of increase continues, there will be 120 or 130 flights per day by the summer of 1959.

Analysis made during the summer shows that more than half suffered "substantial difficulties" as a result of either communications or A.T.C. services. Some 40 per cent of the flights were, it appears, unable to fly at the altitudes they had requested, or had to change their flight plans after departure as a result of A.T.C. instructions. Delays on the ground to aircraft awaiting A.T.C. clearance involved 20 per cent. Of the many flights which suffered from R/T. congestion, 25 per cent were delayed fifteen minutes, and fifteen per cent were unable to communicate with any ground station for periods of between one and two hours.

The main causes of the difficulties are stated to be: (1) unreliable fixed communications among Gander, Greenland, Iceland and Shannon/Prestwick; (2) unreliable and congested air-ground communications, and (3) inadequate position-fixing by aircraft in flight.

So far as item (1) is concerned, unreliability of fixed ground communication is due to radio "blackouts" characteristic of sub-Arctic latitudes. It is recommended that "everything possible" should be done to adopt the promising V.H.F. "forward scatter" system by the summer of 1958. "We believe," says the report, "it is evident that any circuit having the qualities ascribed to the V.H.F. forward scatter would virtually solve the fixed service communications problem in the northern area of the region."

With regard to item (2), unreliability of air-to-ground communications is again due to radio blackouts. Urging that tests on "ground-wave" installations be pressed forward urgently, the report comments: "We believe that the good results obtained from the Greenland and Iceland installations indicate strongly that significant benefits can be obtained in other locations subject to radio blackout if suitable sites for the ground wave stations are selected."

Finally there is the most pressing problem of all—item (3), inadequate position-fixing by aircraft in flight. Here the report seems to be disappointingly inconclusive in its recommendations. It says: "In the absence of accurate and reliable information on the position of aircraft, safety demands that very large separations be maintained among them, which is one of the main causes of apparent congestion of the North Atlantic airspace." It adds: ". . . position information should be available on a virtually continuous basis, without the need for complicated and time-consuming manipulations or computations."

Curiously, however, no mention is made of the equipment which appears to offer the most promise here—Dectra, of which a trial North Atlantic chain is now being completed. The Report suggests, somewhat inconclusively, that if the I.C.A.O. Air Navigation Commission decides that "a Consol plan is not practicable in the present circumstances, the Council should immediately initiate action to establish some other plan for improving navigational coverage." In the next paragraph, however, the report says that "appreciable benefit would be derived from a general use of Loran."

*"*Comments and Recommendations on Air Navigation Facilities and Services in the North Atlantic Region." I.C.A.O. Doc. 7751, PNL/1.*

BOB BRENARD

WE record with regret the death, at the age of 67, of Mr. Robert Brenard, who died on January 4 after three months' illness. Bob Brenard was associated with air transport from its infancy—indeed from its birth. He was the Air Ministry met. officer at Hounslow in 1919 when the world's first scheduled air services were launched to and from Paris by D.H.16s of Aircraft Transport and Travel. In the early twenties he founded the Brenard Air News Service, which since 1946 has been managed by his son, Bill Brenard. His other son, Arthur, is air correspondent of the *Sunday Express*.

The late Bob Brenard is perhaps best remembered for his work as Press officer of Imperial Airways, a position to which he was appointed in 1934, and which he held until the formation of B.O.A.C. during the war years.

IRISH AIR CHARTER

A NEW charter company was formed in Ireland on January 15 with Irish and American backing. Known as "Irish Air Charter, Ltd.," it will operate Piper Apaches. The first aircraft will be flown from the manufacturer's airfield in Pennsylvania, U.S.A., to the company headquarters at Dublin Airport by Captain A. C. Morgan, who is the chief pilot and technical manager of the new enterprise. The chairman is Mr. Dennis Green, principal of a Dublin firm of solicitors; and the managing director is Mr. Tim Vigors, who was an R.A.F. wing commander during the war.

The company say that they hope to carry businessmen, sportsmen, tourists and light freight at charges of about 2s 6d a flying mile. The aircraft—which will be maintained by Aer Lingus—will carry long-range tanks and will be equipped with V.O.R., I.L.S., a radio compass and two V.H.F. communication sets. The offices of Irish Air Charter, Ltd., are at 62 Merrion Square, Dublin.

POLAR PERMANENCE

WELL-ESTABLISHED on their polar California to Scandinavia route since temporary authorization was obtained from the C.A.B. in November 1954, S.A.S. have opened negotiations to make permanent their route authorization, which is due to expire in November this year. As a first step, the Swedish, Norwegian and Danish Ambassadors have asked the U.S. State Department to agree to S.A.S. and C.A.B. negotiations.

The Scandinavian airline appear to have plenty of justification for their request: B.O.A.C. and Lufthansa have already been granted permanent route-authorization, and a C.A.B. examiner has urged that PanAm and T.W.A. be similarly treated. The same request has come from K.L.M. The steady growth of trans-polar traffic and the operating experience already gained by S.A.S. (20,000 passengers in the first two years) are also in their favour.

On February 24, S.A.S. will inaugurate their over-the-pole DC-7C service between Tokyo and Copenhagen. One aircraft will start from each end of the route and will pass each other near the North Pole. The service from Europe to Japan—a stop is made at Anchorage, Alaska—will be flown in 30 hours.

INDIAN MERGER

A SUGGESTION that Air India International and Indian Airlines should merge to form one corporation was proposed in the 41st report of the Estimates Committee of the Indian Government's Ministry of Communications. In the committee's view it was logical to combine the two corporations "as the integration of domestic services has been completed." As the airline boards had seven out of nine members in common they suggested that even if the government were not in favour they should at least examine the feasibility of a common board.

AID FOR THE CLEARSIGHTED

A FORTNIGHT of meetings in London by the Visual Aids Panel of I.C.A.O. ended in London last Saturday. Invited to London by the United Kingdom Government, the panel met to review the visual aid specifications for international aerodromes and to recommend amendments to the I.C.A.O. Annex 14 (Aerodromes). The chairman was Mr. J. M. Lerew, Chief of the Aerodromes Air Routes and Ground Aids Section of I.C.A.O. and the panel consisted of representatives from Austria, Australia, Canada, France, the Netherlands, Sweden, the U.K., Uruguay and the U.S.A. Representatives of I.A.T.A., I.F.A.L.P.A. and the Commission Internationale de l'Eclairage were also in attendance.

Among the items discussed was the need to improve the integration of visual and electronic non-visual approach and landing aids, and a representation that had earlier been made by I.A.T.A. for a greater improvement and standardization of the visual aids for runways not served by radio aids.

SILVER CITY CHANGES

FROM Silver City Airways comes news that the airline has reorganized its commercial department into two new divisions. In the air ferry division, to be concerned with the company's air ferry and "Silver Arrow" services, the principal executives are: Mr. E. Manley Walker, commercial manager (air ferry division); Mr. L. McCracken, reservations manager; and Mr. J. R. Hawkes, sales manager. In the freight and charter division, Mr. Leslie R. Pavey, commercial manager (freight and charter division) is the principal executive.

BREVITIES

THE Anglo-U.S. civil aviation conference at Bermuda "to undertake the complete review of the air service agreement concluded at Bermuda on February 11, 1946" (see *Flight*, November 16) will start on February 18.

* * *

Sabena's twice-daily helicopter service between Paris and Brussels will start on March 3.

* * *

Lower rates will be offered in 1957 on Air Charter's "Channel Air Bridge."

* * *

The Australian Department of Civil Aviation has ordered a Fokker Friendship for delivery in 1959. It will be used for the inspection and control of navigation aids all over Australia.

* * *

Southampton Borough Council have turned down an M.T.C.A. proposal that Eastleigh Airport should be returned to the town's ownership.

* * *

Representatives of the M.T.C.A. are going to Warsaw next month to negotiate an air route from London to Warsaw *via* Copenhagen.

* * *

Mr. R. Boyd Ferris has recently been appointed engineering assistant to the technical director of the International Air Transport Association in Montreal.

* * *

Mr. Whitney Straight, vice-chairman of Rolls-Royce, Ltd., said in Johannesburg on January 15 that nuclear-powered aircraft may be flying between London and Johannesburg and London and New York "in about ten to twelve years' time."

* * *

The C.A.B. examiner's recommendations for direct trans-Pacific services from the U.S. West Coast (see *Flight*, January 4) have been strongly criticized by PanAm. The airline said that these would largely deprive the public and the Post Office of the benefits of effective competition and that they would undermine their ability to remain free of subsidy.

* * *

British and French travellers may now land at Cairo in transit to other countries, but they may not leave the airport.

* * *

Skyways have ordered a Decca type 424 airfield control radar for installation at Lympne.

* * *

An Il-14 which arrived in Djakarta with a Russian crew on January 13 has been presented to President Sukarno of Indonesia.

* * *

K.L.M. is the first airline to order a Link Aviation flight simulator for the Lockheed Electra.

* * *

Mr. James T. Pyle has been sworn-in as U.S. Administrator of Civil Aeronautics following his appointment by President Eisenhower on December 20. He has been Acting Administrator since September 5.

* * *

A Capital Airlines Viscount flew the 602 miles from Birmingham, Alabama, to Pittsburg in 1 hr 44 min, including take-off and landing time. This is believed to be a speed record for a commercial flight in the United States.

* * *

Morton Air Services have been refused permission to operate between Croydon and Dusseldorf, Hamburg and Frankfurt through Rotterdam; but they will increase their services to Rotterdam from two to three a day.

* * *

An Aerolineas Argentinas Viking crashed at Buenos Aires on January 11. Twelve of the 28 passengers and six crew were killed. This was the first accident suffered by the airline in ten years of operation.

CLUB AND GLIDING NEWS

THE Popular Flying Association has begun 1957 with no fewer than 70 affiliated groups and clubs. In the field of amateur construction, over fifty sets of working drawings of the Turbulent and Turbi have been sold, and the first completed machines are expected to fly this year. A new monthly bulletin, *Popular Flying*, is to be produced, with John Blake of the Royal Aero Club as editor. The next P.F.A. rally will be held at Sywell Aerodrome on May 25-26 (subject to final confirmation); it is hoped that the first postwar British-constructed ultra-light aircraft will be demonstrated on this occasion.

THE fifth annual dinner of the Channel Islands Aero Club was held in St. Helier last month, and was attended by 120 members and guests. Guests of honour included Mr. F. Le Boutillier (president, Harbours and Airports Committee), Mr. C. Roche (Jersey Airport commandant), and Mr. W. Griffiths (deputy airport commandant). Both Mr. Le Boutillier and Mr. R. Spears, the Club president, spoke of the increasing need for official support for the Club in view of the difficulties of Club flying in a highly congested control zone, and also to assist the young people of the Channel Islands to learn to fly and to enter Civil Aviation professionally.

At the dinner it was announced that an Airmanship Trophy had been presented to the Club by Mr. T. E. Kilfoy, vice-president (aircraft), to be awarded each year to the most outstanding private pilot in the Club. For 1956 Mr. Kilfoy made the initial award to Mr. R. Spears, the Club president, in recognition of his skilful handling of the Club Auster when force-landing at Le Touquet after experiencing an engine failure over the English Channel in April. This award, news of which was enthusiastically received by all present, was heartily endorsed by W/C. M. E. Pickford, the Club's recently appointed C.F.I.

Proposing the toast of the guests, Mr. R. Jenkinson paid tribute to the co-operation of the Airport authorities and, in particular, to the Jersey air traffic control officers who, although attending to 350 scheduled aircraft movements per day in mid-summer, never prevented local flying by the Club Auster. In conclusion

The presentation of the Kilfoy Airmanship Trophy to Mr. R. Spears of the Channel Islands Aero Club, reported above.

CLUB AND GLIDING NEWS . . .

the wish was expressed that the forthcoming International Air Rally to be organized by the Club in 1957 would be as successful and enjoyable as those held in the past.

ADDITIONAL details have been announced by the Royal Aero Club concerning this year's racing and aerobatic contests (reported briefly in *Flight* last week). Trophies are to be awarded for speed as well as for final placings in the races, and the first prize in the new aerobatic contest will be £100. Further details are as follows:—

Meetings: At Yeadon on June 10 (first two rounds of class races, Royal Aero Club Aerobatic Competition), and at Baginton on July 13 (final rounds of class races, Lockheed Aerobatic Competition, King's Cup Race).

Class Races: (1) Osram Cup (pilot achieving fastest time over course wins Air League Challenge Cup). Each round comprises four ten-mile laps.

(2) Kemsley Challenge Trophy (pilot achieving fastest time over course wins Norton Griffiths Challenge Trophy). Each round comprises three ten-mile laps.

(3) Goodyear Challenge Trophy (pilot achieving fastest time over course wins Grosvenor Challenge Cup). Each round comprises three ten-mile laps.

Prizes of £100, £50 and £25 will be awarded in each round of each race to pilots placed first, second and third, respectively. The British Air Racing Championship will go to the pilot with the highest number of points in the three class races.

King's Cup Race: To be flown over a 112-mile triangular course, Baginton - Sywell - Peterborough - Baginton. Open to British pilots and aircraft which have completed at least one round of the class races. S.B.A.C. Challenge Cup to be awarded to pilot achieving fastest time over course. Entries restricted to aircraft of gross weight not exceeding 1,750 kg (3,858 lb).

British Lockheed International Aerobatic Competition: Eliminating round on July 12, finals on July 13. Two groups, for light and heavy aircraft respectively. Prizes of £300, £250, £200, £150, £100 and £50 donated by Lockheed Hydraulic Brake Co., Ltd., with additional prizes of £50 for the highest marked pilot in each group who fails to qualify for the final.

Royal Aero Club Aerobatic Competition: New event for British pilots in aircraft not exceeding 1,750 kg gross weight. Prizes of £100, £75, £50 and £25 donated by Automotive Products, Ltd.

MEETINGS announced by the Tiger Club for the coming season include a race meeting for Tiger Moths at Sandown Airport, Isle of Wight, on April 21 and 22, and an aerobatic competition for the de Havilland Trophy at the Northamptonshire Aero Club, Sywell, on May 5. This latter occasion is stated to be the official celebration of the Silver Jubilee of the Tiger Moth, which gained its C. of A. in March 1932. The Club has also made the following announcement:—

"Apart from the National Air Races at which, of course, the club's members hope to compete as usual, the Tiger Club will do its best to encourage racing at local club functions, should any club wish to include these in their programme. To this end, the Tiger Club will provide up to six Tiger Moths at any one display, together with the pilots to fly them, but in order to encourage the younger generation of pilots to gain experience in racing, opportunity will be given to a limited number of local pilots from the club visited to take part in the event, provided that (a) they produce a statement from their chief flying instructor confirming that they are, in his opinion, fit to race, (b) they are in possession of a current Royal Aero Club Competitor's Licence, and (c) they become associate members of the Tiger Club before entries for the races close. The aircraft of the Tiger Club will be fully insured for third-party risks, and each will have easily distinguished colour schemes. . ."

A WELL-KNOWN instructor at Fair Oaks Aero Club, and author of *Student and Private Pilot's Handbook*, H. H. ("Eddie") Edwards has recently left this country for an aviation career in the U.S.A.

At Fair Oaks, the two successful socials held during December are to be followed by one on January 26. Messrs. Brock, Black and Bond have obtained P.P.Ls., and a total of 4,827 hours were flown during 1956.

SOME 60 members of the Scottish Aero Club, Perth, attended a very enjoyable Hogmanay Party. Flying rates have been increased following the rise in the cost of petrol and, as many members have considerable distances to travel to the club, the rationing of car fuel has caused a slight drop in attendance.

TO soften the blow of petrol rationing, Lancashire Aero Club have organized a particularly active programme of social events. These events include a film show on January 27, and a Valentine Ball on February 16.

This New Zealand ultra-light, designed by C. G. Andrews, made its first flight at Rongotai Aerodrome on January 2.

Cadets under training at Elstree, with instructor W. H. Bailey (left) and C.F.I. David Ogilvy (right): C. Denham, D. C. Vincent, J. I. Jenkinson, M. J. Talbot and M. R. Smith. A reunion of Elstree-trained scholarship cadets is planned; those interested should contact the C.F.I.

FLYING hours for 1956 at Elstree Flying Club totalled 3,741, compared with 3,180 the previous year. Blaming the weather for the fact that the increase was not greater, C.F.I. David Ogilvy comments that December's figure of 98 hr was the worst for any month in the last three years. Between the 6th and 30th of that month instructors Ogilvy and Bailey flew only ten minutes each; fogs, gales, rain and low cloud keeping them grounded for the remainder of the time. An example of what is possible, however, was the 31-hour total for one day, December 2.

The club's new year has begun with the publication of plans for new instrument-flying and instructors' courses. While not going as far as the Instrument Rating, the instrument course includes 15 hours' basic Link training and five hours' instrument flying in the Chipmunk, and costs £45, or £42 if paid in advance. The courses for the Assistant Instructor's Rating will be full-time, lasting a minimum of 14 days and including 25-30 hours' flying, a course of lectures and practice briefings.

IN spite of last summer's bad weather, a further increase of activity during 1956 has been reported by the Lasham Gliding Centre. Among the year's achievements were 20,812 launches, 3,230 hours flown, and 6,586 cross-country miles, compared with 18,238 launches, 2,730 hours and 4,227 miles during 1955. Flying was possible on 323 days during 1956, and soaring on 168 days.

Three new British records were set up from Lasham during the year. These were the British two-seater out-and-return, the U.K. 100 km single-seater speed, and the U.K. single-seater 200 km triangular speed records. All the 1956 instructional courses were fully booked, and a similar programme has been arranged for this year. A total of 31 gliders and sailplanes are now based at Lasham, 17 of which are privately owned.

RECORDS homologated recently by the B.G.A. include the British national out-and-return record, set up by R. C. Forbes (Weihe) in a flight of 217 miles from Grand Prairie, Texas, to Stephens County Airport, Texas, and return, on August 8, 1956; and the women's British national and U.K. gain-in-height record of 10,500ft by Mrs. Ann Burns (Skylark 3) on December 2, 1956, from the Long Mynd.

RECENTLY elected to Associate Membership of the British Gliding Association is the Northampton Gliding Club, which operates from Sywell Aerodrome. The secretary of the new club is A. G. Clarkson, 6 Mill Road, Kettering, Northants.

Yemen Operations

IN reports from Aden of hostilities on the Protectorate's frontier with the Yemen, R.A.F. Venoms were described as being in action against Yemeni troops in the Beihan area, one of three points where incursions had been made. The Venoms supported troops of the Durham Light Infantry, who drove the Yemenis out of houses on Aden territory. The intruders were attacked with rockets and cannon fire as they ran into scrubland towards the Yemeni side of the frontier.

All British forces in the Protectorate are under R.A.F. control. Apart from the Venoms there is a Flight of Lincolns; for transport duties there are Valettas, Pembrokes and Ansons; and units of the R.A.F. Regiment traditionally form part of the ground forces.

Canberra Court Martial

AT Nicosia, F/O. Dennis Raymond Kenyon, a regular officer of No. 61 Squadron, Upwood, attached to R.A.F. Nicosia, is to be tried by general court martial next Monday, January 28. The charge against him reads: "... on November 1, 1956, when on active service, and when as captain and pilot of Her Majesty's aircraft Canberra WH915 he was under orders to take off from Nicosia and to fly to Egypt in order to carry out a warlike operation in the air, through default, failed to use his utmost exertions to carry such orders into effect by wilfully causing the undercarriage of the said aircraft to be partially retracted before take-off when the said aircraft was stationary on the ground with undercarriage down, with intent to relieve him from carrying the said orders into effect."

There are two alternative charges, one of "wilfully damaging" the aircraft, and the other of "negligently damaging" it.

Malayan Records

ACCORDING to a broadcast report, A.V-M. W. H. Kyle, A.O.C. Malaya, stated that during 1956 helicopters evacuated a record total of 650 military casualties in Malaya.

A.V-M. Kyle also congratulated No. 267 Sqn. for flying 10,000 hr during 1956 without an avoidable accident, and expressed his admiration for its fine achievement in operations against the terrorists.

No. 267 is based at Kuala Lumpur and is commanded by S/L. T. W. G. Godfrey, D.F.C. The squadron operates five types of aircraft, Pioneers, Dakota and Auster loud-hailer aircraft, Pembrokes and Harvards.

The R.Aux.A.F. Disbandment

THE following are from the official lists of R.Aux.A.F. Squadrons which are to be respectively disbanded and retained (comment on the disbandment decision appears on pages 98-99 of this issue):—

TO BE DISBANDED

(Date of formation, present base and name of Honorary Air Commodore given after each unit; certain units at present have no Honorary Air Commodore.)

Fighter Squadrons.—No. 500 (County of Kent), 16.3.31, West Malling, Sir Anthony Eden; No. 501 (County of Gloucester), 14.6.29, Filton, H.R.H. the Duke of Gloucester; No. 502 (Ulster), 15.5.25, Aldergrove, Viscount Brookeborough; No. 504 (County of Nottingham), 26.3.28, Wymeswold, A. Cdre. J. M. Birkin; No. 600 (City of London), 14.10.25, Biggin Hill, H.M. Queen Elizabeth the Queen Mother; No. 601 (County of London), 14.10.25, North Weald, H.R.H. the Duke of Edinburgh; No. 602 (City of Glasgow), 15.9.25, Abbotsinch, the Duke of Hamilton and Brandon; No. 603 (City of Edinburgh), 14.10.25, Turnhouse, H.M. Queen Elizabeth II; No. 604 (County of Middlesex), 17.3.30, North Weald, Viscount Templewood; No. 605 (County of Warwick), 15.10.26, Honiley; No. 607 (County of Durham), 17.3.30, Ouston, Viscount Runciman of Doxford; No. 608 (North Riding), 17.3.30, Thornaby, Viscount Swinton; No. 609 (West Riding), 10.2.36, Church Fenton, A.V-M. G. H. Ambler; No. 610 (County of Chester), 10.2.36, Hooton Park, Viscount Leverhulme; No. 611 (West Lancashire), 10.2.36, Hooton Park; No. 612 (County of Aberdeen), 1.6.37, Dyce, A. Cdre. Finlay Crerar; No. 613 (City of Manchester), 1.3.39, Ringway, Sir Roy Dobson; No. 614 (County of Glamorgan), 1.6.37, Llandow, A Cdre. R. Cadman; No. 615 (County of Surrey), 1.6.37, Biggin Hill, Sir Winston Churchill; No. 616 (South Yorkshire), 1.11.38, Worksop, the Duke of Portland.

A.O.P. Squadrons.—*No. 661*, 1.5.49, Kenley, A.V-M. W. J. Seward. FLIGHTS: No. 1957, Kenley; 1958, Hendon; 1959, Hornchurch; 1960, Kenley.

No. 662, 1.2.49, Colerne, A. Cdre. A. A. Walser. FLIGHTS: 1956, Colerne; 1962, Middle Wallop; 1963, Colerne.

No. 663, 1.7.49, Hooton Park, Viscount Leverhulme. FLIGHTS: 1951, Ringway; 1952, Llandow; 1953, Hooton Park; 1954, Castle Bromwich; 1955, Hooton Park.

No. 664, 1.9.49, Hucknall, A. Cdre. J. M. Birkin. FLIGHTS: 1964, Yeadon; 1965, Usworth; 1969, Wymeswold; 1970, Hucknall.

No. 666, 1.5.49, Scone. FLIGHTS: 1966, Perth; 1967, Abbotsinch; 1968, Turnhouse.

Fighter Control Units.—No. 3504 (County of Nottingham), 8.1.47, Nottingham, A. Cdre. J. M. Birkin; No. 3509 (County of Stafford), 1.11.47, Stoke-on-Trent, the Earl of Shrewsbury and Waterford; No. 3510 (County of Inverness), 22.9.48, Raigmore, Vice-Admiral the Mackintosh of Mackintosh; No. 3512 (County of Devon-Exeter), 22.9.48, Exeter, A. Cdre. H. P. Smyth-Osbourne; No. 3513 (County of Devon-Plymouth), 22.9.48, Plymouth, A. Cdre. H. P. Smyth-Osbourne; No. 3605 (County of Warwick), 22.9.48, Castle Bromwich; No. 3614 (County of Glamorgan), 1.11.47, Llandaff, A. Cdre. R. Cadman; No. 3631 (County of Essex), 1.8.55, Chelmsford.

Radar Reporting Unit.—No. 3700 (County of London), 1.1.50, London, W.1.

Field Squadrons.—No. 2501 (County of Gloucester), 1.5.47, Filton, H.R.H. the Duke of Gloucester; No. 2502 (Ulster), 1.12.47, Aldergrove, Viscount Brookeborough; No. 2504 (County of Nottingham), 1.12.47, Hucknall, A. Cdre. J. M. Birkin; No. 2600 (City of London), 1.5.47, Biggin Hill, H.M. Queen Elizabeth the Queen Mother; No. 2602 (City of Glasgow), 1.12.47, Bishopbriggs, the Duke of Hamilton and Brandon; No. 2603 (City of Edinburgh), 1.5.47, Turnhouse, H.M. Queen Elizabeth II; No. 2605 (County of Warwick), 1.12.47, Honiley; No. 2608 (North Riding), 1.12.47, Thornaby, the Viscount Swinton; No. 2609 (West Riding), 1.5.47, Yeadon, A.V-M. G. H. Ambler; No. 2611 (West Lancashire), 1.10.47, Woodvale; No. 2612 (County of Aberdeen), 1.12.47, Dyce, A. Cdre. Finlay Crerar; No. 2616 (South Yorkshire), 1.12.47, Norton, the Duke of Portland.

TO BE RETAINED

Fighter Control Units.—No. 3500 (County of Kent), 8.1.47, Margate, Sir Anthony Eden; No. 3502 (Ulster), 22.9.48, Edenmore, Viscount Brookeborough; No. 3505 (East Riding), 8.1.47, Sutton-on-Hull, Mr. G. W. Odey; No. 3506 (County of Northampton), 8.1.47, Peterborough, Air Marshal Sir John Baldwin; No. 3507 (County of Somerset), 1.11.47, Rudloe Manor, the Lord Bishop of Bath and Wells; No. 3508 (County of Northumberland), 22.9.48, Long Benton; No. 3511 (City of Dundee), 22.9.48, Dundee, Sir Garnet Wilson; No. 3602 (City of Glasgow), 1.11.47, Glasgow, the Duke of Hamilton and Brandon; No. 3603 (City of Edinburgh), 1.11.47, Edinburgh, H.M. Queen Elizabeth II; No. 3604 (County of Middlesex), 8.1.47, London, W.C.1, Viscount Templewood; No. 3608 (North Riding), 1.11.47, Thornaby, Viscount Swinton; No. 3609 (West Riding), 22.9.48, Yeadon, A.V-M. G. H. Ambler; No. 3611 (West Lancashire), 1.11.47, Fazakerley; No. 3612 (County of Aberdeen), 22.9.48, Dyce, A. Cdre. Finlay Crerar; No. 3613 (City of Manchester), 17.11.48, Ringway, Sir Roy Dobson; No. 3617 (County of Hampshire), 8.1.47, Bournemouth, Air Chief Marshal Sir Douglas Evill; No. 3618 (County of Sussex), 8.1.47, Eastbourne; No. 3619 (County of Suffolk), 8.1.47, Ipswich, the Earl of Cranbrook; No. 3620 (County of Norfolk), 8.1.47, Norwich, A.V-M. F. P. Don; No. 3621 (North Lancashire), 1.3.54, Squires Gate.

Radar Reporting Unit.—No. 3701 (County of Sussex), 1.4.53, Brighton.

Ending a 30 years' association between the R.A.A.F. and the de Havilland Moth family, the Service's last ten Tiger Moths were flown in formation from Point Cook to Tocumwal for disposal on January 9. Here they are seen lined up before the flight. Their place is being taken by Winjeels.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

A B-52 Comes to Britain

LAST week we visited R.A.F. Station, Brize Norton, Oxon, to find it vastly different from the glider-conversion unit we had known 13 years ago. It is now a base of the U.S.A.F. Strategic Air Command, teeming with activity and housing a resident medium bomb wing on rotational training. In every part of the field B-47s squatted at dispersal, rakish and familiar. But in the central area there arose a tail which could never have fitted a B-47; a tail which towered over everything else on the base. We had come to see the first B-52 to visit Britain (see page 96).

We had long looked forward to this meeting; and we were not disappointed. Boeing's masterpiece is truly big, and so logical and efficient in design as to arouse a unique admiration. This particular specimen (which was due to return to Castle A.F.B., near Merced, Cal, on Monday last) was a B-52B-35-BO, built at Seattle two years ago with the Air Force serial 53-395 and since flown for a much longer time than its appearance suggested.

It bore the name *City of Turlock*, for many of the 45 aircraft of the 93rd Heavy Bomb Wing have been proudly adopted by communities in the Merced neighbourhood. The 93rd was the first wing to be fully equipped with the B-52 and now, in addition to its operational function, has commitments as an instructional and development unit. Its three squadrons are the 328th (blue), 329th (red) and 330th (yellow), and although *Turlock* carried the 329th's red stripe on its fin the yellow caps of its crew proclaimed their allegiance to the 330th. A portrait group appears on p. 96.

Normal crew is six, but on the flight to England space was found for an extra pilot and navigator and also a crew chief (maintenance supervisor), the latter wearing the red hat of the unit which owned the aircraft. There were thus nine men aboard, each wearing his Castle "ident-tag" in his overall-zipper. In alphabetical order they were: S/Sgt. A. T. Aroney, tail gunner; Maj. Ben H. Clements (instructor pilot and captain of aircraft); Lt. Walter D. Cooke (electronic countermeasures operator); Capt. Hays F. Griffin (extra navigator); Maj. Robert J. Jones (instructor pilot); S/Sgt. T. A. Rouch (crew chief); Capt. H. R. Sage (radar navigator); Maj. Ernest C. Skorheim (navigator); and Capt Donald L. Taylor (extra instructor pilot).

Crews are not assigned to particular aircraft; "we fly," said Maj. Clements, "whenever we can." His crew passed out in the third B-52 course in the late summer of 1955. He himself had served a tour at Grafton Underwood in World War 2 and most of his crew also knew Britain well. All nine delighted in showing us their mighty piece of equipment. Perhaps the most coherent way of putting together the information which we gathered is to describe a typical B-52 mission.

A Typical Mission

Each crew is assigned one or more "profiles" corresponding in every major respect with an actual mission which they would undertake should S.A.C.'s "M-day" (mobilization for a hot war) ever arrive. Most profiles call for flights of from eight to twelve hours and include an air-refuelling, although the B-52B's colossal fuel capacity of 35,000 U.S. gal can keep it in the air for 15 hr (later B-52s, with 3,000-gal underwing tanks, can fly even further).

If the profile specifies altitudes in excess of 45,000ft—and the B-52 "handles like a fighter" at heights very much greater than this—the crew have to wear pressure suits and take along extra equipment. In any case they have to sign for a mass of radar charts, let-down books and other paraphernalia. Out at dispersal the 52 sits jauntily, her mighty wings curving upwards so that a tall man can just touch the small outrigger wheels near the tips. But after pressure-fuelling through the single socket in the forward landing-gear bay the wings droop enough to press each outrigger very firmly on the ground.

Five of the crew enter through a small hatch under the nose and climb up to their seats on the two decks. Each man has a fully automatic ejection seat, three firing up and two down. The gunner sits in splendid isolation 150ft away and enters through a door beneath the starboard tailplane. He can communicate with the forward section *via* a catwalk, although this requires depressurization. In emergency he can jettison the entire turret and step out through the resulting hole.

Almost 100,000 lb thrust (wet) is provided by the eight Pratt and Whitney J57 two-spool turbojets, of which handling and reliability are outstanding. Compressor-bleed air is used to provide power throughout the aircraft, with main systems by General Electric and Hamilton Standard. All powerplants are ganged together pneumatically for starting by air-turbine motors. Electric power is generated by four 60-kVA alternators driven by air turbines, one pair being located in each of the capacious landing-gear bays. There is no centralized hydraulic system, localized systems being served by air-turbine-driven pumps. Air from the engines also energizes the pressurization and conditioning packs for the forward section and gunner's compartment, and—although rarely needed—assists in protection against icing.

The B-52 is taxied on its two inner engines, steering hydraulically with Nos. 1 and 2 (front) trucks of the landing gear (each of which carries forward-facing lights). The four enormous flap sections are rolled out to take-off position, each section running on four steel tracks and pushed out by twin ball-bearing screw-jacks energized by local hydraulic systems. All is then ready for take-off. The J57 accelerates very rapidly, and the eight power levers are slim and closely spaced and can all be held in one hand "like a stack of poker chips." The outriggers are retracted early and when finally clean the B-52 can climb fast, even at 200 tons.

Various types of climb procedure are followed. The interior cabin pressure is held at 8,000ft equivalent, and the heating can almost drive the crew out of the flight deck if turned up too high. Sun glare on the instruments is reduced by green transparent shields around the whole deck. The large windscreens are made of Nesa heated glass and have wipers. Navigation is mainly celestial, for at high altitude the stars are visible around the clock and unobscured by any weather. Various radar systems can also be employed; for example, P.P.I. equipment can be used over oceans to spot ships and enable wind-finding runs to be made. Loran is not carried.

Air Refuelling

After a few hours a refuelling may be called for. Until the KC-135 enters service later this year the tankers remain the KC-97, to rendezvous with which the B-52 has to lose a lot of speed and altitude. The two aircraft meet by identifying radar and transponder links, the bomber pilot opening his spoilers and possibly dropping the landing gear in order to let down steeply. For night fuellings the undercarriage lights may be switched on and further lights are provided in the doors to the refuelling socket in the roof of the fuselage, shining along the wings and helping the KC-97 boom-operator to make contact. With its multiple tanks the B-52 can drain a KC-97 in little over a minute.

Alone again, the B-52 can head for its "target," where pictures may be taken by the MA-2 or "Brane" radar bombing and navigation systems. The weapons bay, between the fore and aft sets of wheels, is bigger than photographs suggest, and numerous stencilled instructions advise upon loading "special bombs." At least four of the crew are always on duty, but a bunk is available at the rear of the upper deck. The gunner has his own relief gear, hot-cup and oven, but his ride is normally appreciably rougher than that of the crew up front. His four 0.50in guns (20 mm in some B-52s) are automatically laid by G.E. monopulse radar, with visual stand-by. Fighter lock-ons are a regular part of training.

From the cockpit the wings can be seen gradually unbending as fuel is burnt, the auxiliary tanks feeding the main tank supplying the powerplants. The whole upper wing skin between the spars is milled from a single sheet from the centre-line to beyond the outer engines. Lateral control is effected by the 8ft tab-operated ailerons (ahead of which is a row of turbulators) and the big, castellated spoilers. Pitch control is provided by the manual/electric elevators and by the vast trimming tailplane, moved by multiple hydraulic ball-bearing nuts running in vertical irreversible screw jacks. Should the tailplane hydraulics fail the gunner can work the surface manually with a 200 : 1 reduction.

Engine failure is countered by biassing the narrow-chord rudder and selecting No. 2 spoiler position to keep the aircraft level. Conversion to the 52 involves many landings with four engines on one side at idling r.p.m., i.e., fully asymmetric.

Let-down with spoilers and/or landing gear extended is very steep, and circuit flying is simple. All four landing-gear trucks can be steered hydraulically and the neutral position may be offset for cross-wind landings, removing cross-wind limits entirely. Wind is obtained from the tower, the component read off from a cockpit chart and the eight wheels turned accordingly. Approach is flat and engine r.p.m. can be held right down as a result of their quick response. On final approach the tailplane goes to full negative incidence and the 48ft brake chute is dropped in a box and streamed. Ideally all four trucks touch the runway together; the second-best choice is rear wheels first. Runway requirements are moderate, except in regard to pavement strength.

While *City of Turlock* was parked at Brize Norton it was inspected by Air Chief Marshal Sir Dermot Boyle, Chief of the Air Staff; Air Marshal Sir Harry Broadhurst, A.O.C-in-C. Bomber Command (who expects to be fit in March); A.V-M. K. B. B. Cross (A.O.C. 3 Group); and A. Cdre. G. A. Walker (A.O.C. and Commandant, R.A.F. Flying College). Although pointing out that British requirements for bomber range do not call for so big an aeroplane they nevertheless expressed very high regard for the big visitor. It may be supposed that Heavy Bomb Wings equipped with B-52s will start rotational training in Britain later this year.